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SAGE INSTRUMENTS
MODEL 930A
COMMUNICATIONS TEST SET

OPERATIONS MANUAL

REVISION 3.0 7/30/90

SOFTWARE VERSIONS 3.25 AND ABOVE

SAGE INSTRUMENTS
240 AIRPORT BLVD.
FREEDOM, CA 95019-2614
(408)761-1000

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TABLE OF CONTENTS

SECTION	TITLE	PAGE
I	**GENERAL INFORMATION**	
1-1	Introduction	1-1
1-2	Specifications	1-1
1-3	Description	1-1
1-4	A Word About Softkey Controlled Test Sets	1-5
1-5	Accessories Available	1-6
1-6	Warranty	1-7
II	**INSTALLATION**	
2-1	Introduction	2-1
2-2	Initial Inspection	2-1
2-3	Preparation For Use	2-1
2-4	Operating Environment	2-3
2-5	Storage And Shipment	2-3
2-6	Physical Description	2-5
III	**OPERATION**	
3-1	Introduction	3-1
3-2	Getting The 930A To Do What You Want	3-1
3-2.1	When First Turning On The 930A	3-3
3-2.2	How To Cold Boot The 930A Or What To Do In Case It Does Not Seem To Work Properly	3-3
3-3	Front Panel Controls, Indicators and Connectors	3-7
3-3.1	How To Use The Numeric Keypad	3-7
3-3.2	How To Use The Special Function Keys	3-8
3-3.2.1	How To Store Settings And Test Set-Ups	3-11
3-3.2.2	Details Of The Store Feature	3-12
3-3.2.3	How To Recall What You Have Stored	3-15
3-3.2.4	Example Of Storing And Recalling	3-16
3-3.2.5	How To Enter And Clear Data	3-21
3-3.2.6	How To Use The Help Key	3-21
3-3.3	Using The Hook Switch To Seize And Release Trunks	3-23
3-4	How To Select The Trunk Type	3-25

TABLE OF CONTENTS (CONT'D)

SECTION	TITLE	PAGE
3-4.1	Types Of Trunks And Where You Find Them	3-25
3-4.2	How To Set-Up A Trunk Type On The 930A	3-26
3-4.2.1	EXAMPLE: Setting Up An E&M Trunk	3-27
3-4.3	Where To Find Optional Trunk Types	3-30
3-4.4	How To Connect Test Cords to the 930A	3-33
3-4.5	How To Find And Use The 930A's Basic Test Functions	3-35
3-5	How To Place A Call Using The Dial/Ring Function	3-39
3-5.1	Details Of Dial/Ring Operation	3-41
3-5.2	How To Store And Recall Phone Numbers	3-43
3-5.3	Transmission Level Point (TLP) Compensation	3-45
3-6	How To Measure Return Loss With The 930A	3-47
3-6.1	Details Of Key Operation In Return Loss	3-48
3-6.2	Trans-Hybrid Loss And How To Measure It	3-50
3-7	How To Send A Tone From The 930A	3-53
3-7.1	Details Of The Send Tone Function	3-55
3-8	How To Measure The Level And Frequency Of Tones	3-59
3-8.1	Details Of Key Operation In Measure Tone	3-60
3-9	How To Measure Noise And Signal-To-Noise	3-63
3-9.1	Example Of Measuring Signal-To-Noise	3-64
3-9.2	Details Of Key Operation In Measure Noise	3-65
3-10	Finding What You Want Under The **Option Menu** Key	3-67
3-10.1	How To Get Into The Menu Once You Find It	3-68
3-10.2	Changing The Dial/Ring Defaults **(Menu Option 1)**	3-69
3-10.2.1	Changing The Level, Frequency And Timing Of MF Or DTMF Digits	3-70
3-10.2.2	How To Change The %Break, Rate And Interdigit Time Of Dial Pulse (DP) Digits	3-73
3-10.3	How To Build A Call Sequence **(Menu Option 2)**	3-75
3-10.3.1	How To Build A Feature Group D Sequence In The 930A	3-75
3-10.3.2	How To Place A Call On A Wink Start Trunk	3-85
3-10.3.3	How To Send A Call More Than 18 Digits Long	3-89
3-10.3.4	Additional Features Of Menu Option 2	3-90
3-10.4	How To Use The DC Voltmeter **(Menu Option 6)**	3-93
3-10.5	How To Change The Supervision Voltage Thresholds **(Menu Option 7)**	3-97
3-10.5.1	Supervision Threshold Ranges	3-98

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TABLE OF CONTENTS

SECTION	TITLE	PAGE
I	**GENERAL INFORMATION**	
1-1	Introduction	1-1
1-2	Specifications	1-1
1-3	Description	1-1
1-4	A Word About Softkey Controlled Test Sets	1-5
1-5	Accessories Available	1-6
1-6	Warranty	1-7
II	**INSTALLATION**	
2-1	Introduction	2-1
2-2	Initial Inspection	2-1
2-3	Preparation For Use	2-1
2-4	Operating Environment	2-3
2-5	Storage And Shipment	2-3
2-6	Physical Description	2-5
III	**OPERATION**	
3-1	Introduction	3-1
3-2	Getting The 930A To Do What You Want	3-1
3-2.1	When First Turning On The 930A	3-3
3-2.2	How To Cold Boot The 930A Or What To Do In Case It Does Not Seem To Work Properly	3-3
3-3	Front Panel Controls, Indicators and Connectors	3-7
3-3.1	How To Use The Numeric Keypad	3-7
3-3.2	How To Use The Special Function Keys	3-8
3-3.2.1	How To Store Settings And Test Set-Ups	3-11
3-3.2.2	Details Of The Store Feature	3-12
3-3.2.3	How To Recall What You Have Stored	3-15
3-3.2.4	Example Of Storing And Recalling	3-16
3-3.2.5	How To Enter And Clear Data	3-21
3-3.2.6	How To Use The Help Key	3-21
3-3.3	Using The Hook Switch To Seize And Release Trunks	3-23
3-4	How To Select The Trunk Type	3-25

TABLE OF CONTENTS (CONT'D)

SECTION	TITLE	PAGE
3-4.1	Types Of Trunks And Where You Find Them	3-25
3-4.2	How To Set-Up A Trunk Type On The 930A	3-26
3-4.2.1	EXAMPLE: Setting Up An E&M Trunk	3-27
3-4.3	Where To Find Optional Trunk Types	3-30
3-4.4	How To Connect Test Cords to the 930A	3-33
3-4.5	How To Find And Use The 930A's Basic Test Functions	3-35
3-5	How To Place A Call Using The Dial/Ring Function	3-39
3-5.1	Details Of Dial/Ring Operation	3-41
3-5.2	How To Store And Recall Phone Numbers	3-43
3-5.3	Transmission Level Point (TLP) Compensation	3-45
3-6	How To Measure Return Loss With The 930A	3-47
3-6.1	Details Of Key Operation In Return Loss	3-48
3-6.2	Trans-Hybrid Loss And How To Measure It	3-50
3-7	How To Send A Tone From The 930A	3-53
3-7.1	Details Of The Send Tone Function	3-55
3-8	How To Measure The Level And Frequency Of Tones	3-59
3-8.1	Details Of Key Operation In Measure Tone	3-60
3-9	How To Measure Noise And Signal-To-Noise	3-63
3-9.1	Example Of Measuring Signal-To-Noise	3-64
3-9.2	Details Of Key Operation In Measure Noise	3-65
3-10	Finding What You Want Under The **Option Menu** Key	3-67
3-10.1	How To Get Into The Menu Once You Find It	3-68
3-10.2	Changing The Dial/Ring Defaults **(Menu Option 1)**	3-69
3-10.2.1	Changing The Level, Frequency And Timing Of MF Or DTMF Digits	3-70
3-10.2.2	How To Change The %Break, Rate And Interdigit Time Of Dial Pulse (DP) Digits	3-73
3-10.3	How To Build A Call Sequence **(Menu Option 2)**	3-75
3-10.3.1	How To Build A Feature Group D Sequence In The 930A	3-75
3-10.3.2	How To Place A Call On A Wink Start Trunk	3-85
3-10.3.3	How To Send A Call More Than 18 Digits Long	3-89
3-10.3.4	Additional Features Of Menu Option 2	3-90
3-10.4	How To Use The DC Voltmeter **(Menu Option 6)**	3-93
3-10.5	How To Change The Supervision Voltage Thresholds **(Menu Option 7)**	3-97
3-10.5.1	Supervision Threshold Ranges	3-98

TABLE OF CONTENTS (CONT'D)

SECTION	TITLE	PAGE
3-10.5.2	How To Work With 24 Volt Supervision	3-100
3-10.5.3	How To Change Loop Supervision Thresholds	3-100
3-10.5.4	How To Change Ground Start Thresholds	3-103
3-10.5.5	How To Change E&M Supervision Thresholds	3-105
3-10.6	Measuring Supervision Event Times **(Menu Option 8)**	3-109
3-10.6.1	Monitoring Ground Start Supervision	3-113
3-10.6.2	Measuring ABC&D Bit Supervision On PCM Channels	3-115
3-10.6.3	How To Print Measurement Results	3-119
3-10.7	How To Measure Wink Timing **(Menu Option 9)**	3-121
3-10.8	Using The Frequency Sweep **(Menu Option 10)**	3-123
3-10.9	How To Stop The 930A From Beeping **(Menu Option 15)**	3-133
3-10.10	How To Change The TLP **(Menu Option 30)**	3-135
3-10.11	How To Send A Hook Flash **(Menu Option 31)**	3-139
3-10.12	Using The Dial-Up Testline **(Menu Option 32)**	3-141
3-10.13	Using The Dial-Up Sweep **(Menu Option 33)**	3-143
3-10.14	DSP Memory Test **(Menu Option 90)**	3-145
3-10.15	Where To Find The Software Version **(Menu Option 91)**	3-146
3-10.16	How To Do A Software Cold-Boot **(Menu Option 92)**	3-147
3-10.17	The Test Display **(Menu Option 93)**	3-148
3-10.18	How To Find Out What Options Are Installed In Your 930A **(Menu Option 94)**	3-148
3-10.19	How To Test Dry Circuits With The 930A **(Menu Option 95)**	3-151
3-10.20	Sending Dial-Tone, Busy and Other Dual Tone Signals **(Menu Option 35)**	3-153
3-10.21	Setting The 930A To Work On Ground Start Coin Phone Trunks **(Menu Option 65)**	3-158

IV OPTIONS

4-1	Introduction	4-1
4-1.1	Useful Trunk Type/Menu Option Combinations	4-5
4-2	The MF/DTMF/DP Receiver/Analyzer (Option 930A-01)	4-7
4-2.1	How To Use the Digit Receiver **(Menu Option 4)**	4-8
4-2.2	How To Receive Calls On PBX Or POTS Trunks	4-17
4-2.3	Receiving Calls On PBX Ground Start Trunks	4-23

TABLE OF CONTENTS (CONT'D)

SECTION	TITLE	PAGE
4-2.4	Receiving An Equal Access Call Sequence On A T-1 PCM Channel	4-29
4-2.4.1	Using The Digit Receiver Scan Mode	4-36
4-2.5	More About Equal Access Calls	4-37
4-2.6	More About Analyzing Received Digits	4-39
4-2.6.1	Examples Of Digit Analysis	4-46
4-2.6.2	Multifrequency (MF) Parameter Values	4-48
4-2.6.3	Touch-Tone (DTMF) Parameter Values	4-50
4-2.6.4	Dial Pulse (DP) Parameter Values	4-51
4-2.7	To Margin The Wink Duration Of The 930A **(Menu Option 12)**	4-53
4-3	SF Supervision (Option 930A-02)	4-57
4-4	Peak To Average Ratio (P/AR) (Option 930A-06) **(Menu Option 18)**	4-61
4-5	3-Level Impulse Noise (Option 930A-07) **(Menu Option 11)**	4-65
4-6	ROTL/Responder/Interrogator (Option 930A-12)	4-77
4-6.1	Using The 930A As A Type 105 Far End Responder **(Menu Option 25)**	4-77
4-6.1.1	Responder Testing Using The Digit Receiver **(Menu Option 4)**	4-81
4-6.2	Using The 930A As A ROTL/Near-End Responder **(Menu Option 26)**	4-87
4-6.2.1	ROTL Testing Using SEND DIGIT SEQUENCES **(Menu Option 2)**	4-94
4-6.3	Using The 930A To Interrogate A ROTL **(Menu Option 27)**	4-97
4-6.3.1	Entering The ROTL Priming Digits	4-99
4-6.3.2	Responder Conditioning Set-Up	4-101
4-6.3.3	Interrogator Test Selection	4-102
4-6.3.4	Testing With The Interrogator Function	4-103
4-6.3.5	Tables Of ROTL Priming Digits	4-110
4-7	The Ring Generator And REN-3 Load (Option 930A-13)	4-115
4-7.1	Changing The Ring Generator Level And Frequency **(Menu Option 1)**	4-116

TABLE OF CONTENTS (CONT'D)

SECTION	TITLE	PAGE
4-7.2	Measuring Ringer Voltage And Frequency Using The REN-3 Load **(Menu Option 5)**	4-121
4-8	Phase/Amplitude Jitter and Hits (Option 930A-18)	4-125
4-8.1	To Measure Phase/Amplitude Jitter **(Menu Option 13)**	4-125
4-8.2	Phase Hits, Gain Hits and Dropouts **(Menu Option 11)**	4-127
4-8.3	How To Change The Default Settings	4-130
4-9	Envelope Delay Distortion (Option 930A-19)	4-135
4-9.1	Measuring Envelope Delay Distortion **(Menu Option 17)**	4-136
4-9.2	EDD Measurement In The SEND Mode	4-141
4-9.3	EDD Measurement In The Repeat Or Slave Mode	4-144
4-10	Intermodulation Distortion (Option 930A-20)	4-149
4-10.1	Making A 4-Tone IMD Test On a Four-Wire Circuit	4-155
4-11	Batch Mode Testing With The 930A (Option 930A-29)	4-159
4-11.1	How Batch Mode Works	4-159
4-11.2	Batch Mode Capabilities and Examples	4-161
4-11.3	Key Functions In Batch Mode	4-163
4-11.3.1	Possible Events In The Call Sequence	4-166
4-11.3.2	Batch Mode Example	4-172
4-11.3.3	Storing Test Results	4-177
4-11.4	Testing Using Batch Mode	4-183
4-11.4.1	Storing And Recalling Test Results	4-184
4-11.5	Calling A 102 Test Line **(Menu Option 29)**	4-187
4-12	Testing To Type 125 Transponders (Option 930A-35)	4-193
4-12.1	How To Set Up Menu Option 28: TRANSPONDER TEST	4-193
4-12.2	How To Test To A Type 125 Transponder	4-196
4-13	Using The 930A As An E911 PSAP Simulator	4-201

V REMOTE CONTROL

5-1	Introduction	5-1
5-1.1	Selecting The Remote Mode	5-4
5-1.2	Setting The Serial Interface Format	5-5
5-1.3	Setting The Time and Date	5-9
5-2	Using The 930A In The Printer Mode	5-11
5-2.1	Introduction	5-11
5-2.2	Setting-Up The Print Function	5-12

TABLE OF CONTENTS (CONT'D)

SECTION	TITLE	PAGE
5-2.2.1	Printer Hand Shake	5-14
5-2.3	Printer Applications	5-16
5-2.4	Printer Report Formats	5-17
5-3	Operation in the Terminal Mode	5-19
5-3.1	Terminal Set-Up	5-20
5-3.2	Terminal Keys	5-22
5-3.3	Terminal CRT Display	5-24
5-3.4	Troubleshooting	5-25
5-4	Computer Operation	5-26
5-4.1	Introduction	5-26
5-4.2	Setting Up The Computer Mode	5-29
5-4.3	Input to the 930A	5-31
5-4.4	Output From the 930A	5-31
5-4.5	Display Line Formats	5-32
5-4.6	Programmers Notes	5-35
5-4.6.1	Initializing The 930A	5-35
5-4.6.2	Using The HELP Menus	5-37
5-4.6.3	When Does The 930A Send A Bell?	5-44

VI T-CARRIER MEASUREMENTS

6-1	The T-1 PCM Trunk Type Interface (Option 930A-08E or -09E)	6-1
6-1.1	How To Change PCM Channels And Test Direction	6-4
6-1.2	How To Change The PCM Default Settings	6-7
6-2	How To Monitor A T-1 Span	6-13
6-3	How To Monitor Both Directions On A T-1 Span	6-15
6-4	Terminating A T-1 Span For Out-Of-Service Testing	6-17
6-5	Drop and Insert Testing on a T-1 Line	6-21
6-6	How To Measure Frame Slips, BPVs And Other Errors With The 930A **(Menu Option 43)**	6-27
6-7	How To Measure The T-1 Voltage At The DSX Jacks **(Menu Option 41)**	6-31
6-8	To Check A/B/C/D Bit States On All 24 Channels **(Menu Option 20)**	6-33

TABLE OF CONTENTS (CONT'D)

SECTION	TITLE	PAGE
6-9	To Toggle The A/B/C/D Bits Or View Both Directions Simultaneously **(Menu Option 21)**	6-35
6-10	How To Measure A/B/C/D Bit Timing **(Menu Option 8)**	6-37
6-11	How To Define Your Own ON/OFF-HOOK States	6-41
6-12	How To Select Foreign Exchange Supervision	6-44
6-13	How To Send PCM Alarms And Force Frame Slips **(Menu Option 40)**	6-47
6-14	How To Detect T-1 Wander Or Clock Difference **(Menu Option 42)**	6-50
6-15	How To Inject A BPV Or Frame Error **(Menu Option 45)**	6-55
6-16	T-1 Error History **(Menu Option 44)**	6-58
6-17	DS-1 Bit Error Rate Testing With The 930A **(Menu Option 46)**	6-63
6-17.1	Bit Error Testing Using The 930A	6-64
6-17.2	How To Change Test Patterns, Framing And Other Parameters	6-67
6-17.3	BER Testing T-1 Interoffice Facilities With The 930A	6-73
6-17.4	Testing Toward A T-1 CSU With The 930A	6-75
6-17.5	BER Testing Two T-1 Spans Simultaneously	6-79
6-17.6	How To Send Errors And Select Other Types	6-81
6-17.7	Testing A T-1 Automatic Protection Switch (APS) **(Menu Option 47)**	6-83
6-18	DS-0 Bit Error Rate Testing (BERT) With The 930A **(Menu Option 56)**	6-87
6-18.1	How To Set Up The 930A For DS-0 BER Testing	6-88
6-18.2	DS-0 BER Testing	6-91
6-18.2.1	Point-To-Point BER Testing Using Two 930As	6-92
6-18.2.2	Loopback BER Testing on 56 KBps DDS® Trunks	6-95
6-18.3	How To Make The 930A Give A Loopback	6-99

TABLE OF CONTENTS (CONT'D)

LIST OF TABLES

TABLE	TITLE	PAGE
1-1	Specifications	1-7
3-1	Standard Menu Option Locations	3-67
4-1	Option Menu Numbers	4-3
4-2	Multifrequency (MF) Codes	4-48
4-3	MF Sender Interdigit Intervals	4-49
4-4	Step By Step Office Mini-ROTL Priming Digit Format	4-110
4-5	Step By Step Office Expanded Format	4-111
4-6	No. 1 ESS ROTL Priming Digits Format	4-111
4-7	No. 4 ESS ROTL Priming Digits Format	4-112
4-8	GTD-5, ITT 1210 Priming Digits Format	4-112
4-9	DMS 100/200 ROTL Priming Digits Format	4-112
5-1	ASCII to Front Panel Key Conversions	5-27
5-2	Special ASCII Characters For Remote Control	5-28

LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
1-1	Model 930A and Accessories	1-4
2-1	SAGE Instruments Model 930A	2-2
2-2	Model 930A Front Panel	2-4
2-3	Configurator Panels	2-6
2-4	Model 930A Rear Panel	2-8
2-5	Model 930A Interior View	2-10
3-1	Front Panel Layout	3-6
3-2	How To Store A Set-Up Or Function	3-10
3-3	Recalling What Has Been Stored	3-14
3-4	Using the ENTER, CLEAR And HELP keys	3-20
3-5	How To Use the Hook Switch	3-22

TABLE OF CONTENTS (CONT'D)

LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
3-6	How To Set-Up Analog Trunk Types	3-24
3-7	Connection of Test Cords	3-32
3-8	Commonly Performed Tests	3-34
3-9	Placing a Call	3-38
3-10	Measuring Return Loss	3-46
3-11	Sending a Tone	3-52
3-12	Measuring a Tone	3-58
3-13	Noise Measurement	3-62
3-14	Menu Option Selection	3-66
3-15	Equal Access Call Progression Diagram	3-76
4-1	The Digit Receiver/Analyzer	4-6
4-2	SF Trunk Type Selection	4-56
4-3	P/AR Measurement Option	4-60
4-4	3-Level Impulse Noise Option	4-64
4-5	ROTL/Responder/Interrogator	4-76
4-6	Interrogator Connected At ROTL Access Port	4-97
4-7	Ring Generator Operation	4-114
4-8	Phase/Amplitude Jitter Option	4-124
4-9	Envelope Delay Distortion	4-134
4-10	4-Tone Intermodulation Distortion	4-148
5-1	RS-232C Connector Location	5-2
5-2	RS-232C Connector Pinouts	5-3
5-3	Terminal CRT Display	5-21
6-1	PCM Trunk Type Selection	6-2
6-2	Monitoring One Direction On A T-1	6-13
6-3	Dual Direction Monitoring With the 930A	6-15
6-4	Terminating A T-1 Span For Out-Of-Service Testing	6-17
6-5	Preparation For Dual Direction Drop and Insert	6-21
6-6	Test Cord Connection For Drop and Insert Testing	6-23
6-7	Dual Direction Drop And Insert	6-25
6-8	Test Cord Connections For Error Monitoring	6-27

TABLE OF CONTENTS (CONT'D)

LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
6-9	Measuring T-1 Voltage At The DSX Monitor Jack	6-31
6-10	T-1 Supervision Event Timing With The 930A	6-38
6-11	Sending Alarms Or Forcing Slips From The 930A	6-48
6-12	930A Connected For Wander Measurement	6-51
6-13	Injecting Errors With The 930A	6-55
6-14	DS-1 (T-1) Bit Error Rate Testing	6-62
6-15	Test Cord Connections For Single Direction BERT	6-65
6-16	Test Cord Connections For Dual-Direction BERT	6-66
6-17	DS-0 Bit Error Rate Testing	6-86

LIST OF MENU OPTION NUMBERS

MENU OPTION NUMBER	DESCRIPTION	PAGE
OPTION NUMBER: 1	MODIFY DIAL/RING	3-69
OPTION NUMBER: 2	SEND DIGIT SEQUENCES	3-75
OPTION NUMBER: 3	REMOTE CONTROL	5-1
OPTION NUMBER: 4	DIGIT RECEIVER	4-7
OPTION NUMBER: 5	REN-3 LOAD	4-121
OPTION NUMBER: 6	D.C. MULTIMETER	3-93
OPTION NUMBER: 7	SUPERVISION THRESHOLDS	3-97
OPTION NUMBER: 8	SUPERVISION MONITOR	3-109, 6-37
OPTION NUMBER: 9	WINK TIMING	3-121
OPTION NUMBER: 10	FREQUENCY SWEEP	3-123
OPTION NUMBER: 11	IMPULSE NOISE & HITS	4-65
OPTION NUMBER: 12	WINK MARGINING	4-53
OPTION NUMBER: 13	PHASE/AMPLITUDE JITTER	4-125
OPTION NUMBER: 14	SET TIME AND DATE	5-9
OPTION NUMBER: 15	BEEP ON ERROR	3-133
OPTION NUMBER: 16	RESERVED	
OPTION NUMBER: 17	ENVELOPE DELAY DISTORTION	4-135
OPTION NUMBER: 18	PEAK/AVERAGE RATIO	4-61

TABLE OF CONTENTS (CONT'D)

LIST OF MENU OPTION NUMBERS

MENU OPTION NUMBER	DESCRIPTION	PAGE
OPTION NUMBER: 19	4-TONE INTERMODULATION	4-149
OPTION NUMBER: 20	24 BIT DISPLAY	6-33
OPTION NUMBER: 21	TOGGLE A/B BITS	6-35
OPTION NUMBER: 22	RESERVED	N/A
OPTION NUMBER: 23	RESERVED	N/A
OPTION NUMBER: 24	RESERVED	N/A
OPTION NUMBER: 25	FAR END RESPONDER	4-77
OPTION NUMBER: 26	ROTL/NEAR END RESPONDER	4-87
OPTION NUMBER: 27	ROTL INTERROGATOR	4-97
OPTION NUMBER: 28	TRANSPONDER TEST	4-193
OPTION NUMBER: 29	CALL 102 LINE	4-187
OPTION NUMBER: 30	ADJUST TLP	3-135
OPTION NUMBER: 31	SEND HOOK FLASH	3-139
OPTION NUMBER: 32	DIAL-UP TESTLINE	3-141
OPTION NUMBER: 33	DIAL-UP SWEEP	3-143
OPTION NUMBER: 34	SELECT REPORTS	N/A
OPTION NUMBER: 35	DUAL TONE SENDER	3-153
OPTION NUMBER: 37	LINE STATUS	N/A
OPTION NUMBER: 40	SEND PCM ALARMS	6-47
OPTION NUMBER: 41	READ T1 VOLTAGE	6-31
OPTION NUMBER: 42	T1 WANDER	6-50
OPTION NUMBER: 43	ERROR COUNTERS	6-27
OPTION NUMBER: 44	T1 ERROR HISTORY	6-58
OPTION NUMBER: 45	T1 ERROR INJECT	6-55
OPTION NUMBER: 46	DS-1 BIT ERROR RATE	6-63
OPTION NUMBER: 47	APS TEST	6-83
OPTION NUMBER: 50	BATCH MODE	4-159
OPTION NUMBER: 51	TEST REPORTS	4-184
OPTION NUMBER: 52	E911	Application Note 3
OPTION NUMBER: 56	DS-0 BIT ERROR RATE	6-87
OPTION NUMBER: 57	DS-0 LOOPBACK	6-99
OPTION NUMBER: 65	GND-ST COIN PHONE	3-158
OPTION NUMBER: 89	PRINTER HAND SHAKE	5-14
OPTION NUMBER: 90	DSP MEMORY TEST	3-145

TABLE OF CONTENTS (CONT'D)

LIST OF MENU OPTION NUMBERS

MENU OPTION NUMBER	DESCRIPTION	PAGE
OPTION NUMBER: 91	SOFTWARE VERSION	3-146
OPTION NUMBER: 92	SOFTWARE COLD-BOOT	3-147
OPTION NUMBER: 93	TEST DISPLAY	3-148
OPTION NUMBER: 94	LIST OPTIONS	3-148
OPTION NUMBER: 95	DRY CIRCUIT	3-151
OPTION NUMBER: 96	TEST EXTENDED RAM	N/A
OPTION NUMBER: 97	HOLD CONTROL	N/A

SECTION I
GENERAL INFORMATION

1-1 INTRODUCTION

This operating manual contains general information regarding the installation and operation of the SAGE Model 930A Communications Test Set. Figure 1-1 shows the instrument and optional accessories available.

1-2 SPECIFICATIONS

The instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument is tested. Options for the instrument have separate specifications which are provided on supplementary specification sheets.

1-3 DESCRIPTION

The Model 930A Communications Test Set combines the functions of a Transmission Impairment Set, a Return Loss Measurement Set, Dial Pulse, Touch Tone (DTMF) and Multi-Frequency (MF) Sender, and Talk Battery supply into one lightweight package. Hardware and software options allow the user to greatly increase the capabilities of the 930A. These options include:

DP, DTMF, MF Receiver/Analyzer with Trunk Simulation
SF Supervision
P/AR Receiver/Transmitter
3-Level Impulse Noise
RS-232C Remote Control/Printer Interface
DS-1 PCM Transmit/Receive (Single or Dual Direction)
with D4/Superframe, Extended Superframe and SLC-96 Capability
Type 105 ROTL/Interrogator/Responder (52A Format)
Ring Generator/REN-3 Load
LTTP/STTP Interface (#1/1A ESS Switch)
FXO/FXS Supervision
Phase/Amplitude Jitter and Hits Measurement
Non-Linear Distortion Measurement
Envelope Delay Distortion Measurement
DS-0/DS-1 Bit Error Rate Testing

The Model 930A performs the three basic functions required of a **DEMARC** test set in today's environment. These are: Transmission Measurements, Signaling and Supervision, and T-1 PCM Drop/Insert (optional) testing.

The Model 930A has been designed to access and perform tests on the following types of circuits:

Equal Access (Feature Group D)
Centralized Automatic Message Accounting (CAMA)
Traffic Service Position System (TSPS)
Toll
International Direct Distance Dialing (IDDD)
Data
PBX
Private Line Automatic Ringdown (PLAR)
Manual Ringdown (MRD)
Foreign Exchange Office and Station ends (FXO/FXS) (optional)
DS-1 PCM Single Direction D4 Superframe and ESF (optional)
DS-1 PCM Dual Direction Drop/Insert D4 Superframe and ESF (optional)

The Model 930A can simulate the telephone company central office or the terminating end of the circuit (Customer Provided Equipment, an Inter-LATA carrier, DEMARC, or Point of Presence).

Sections IV, V, and VI of this manual describe the operation of the Options you may have purchased for the 930A.

The transmission measurements which the 930A can make are:

1. Level and Frequency
2. Noise (C-MSG, C-Notch, 3 KHz Flat and Signal-to-Noise)
3. Noise-to-Ground
4. Noise with Tone
5. Return Loss (2-Wire and 4-Wire)
6. DC Voltage and Current
7. P/AR (Option 930A-06)
8. 3-Level Impulse Noise & Hits (Option 930A-07 & -18)
9. Phase/Amplitude Jitter (Option 930A-18)
10. 4-Tone Intermodulation Distortion (Option 930A-20)
11. Envelope Delay Distortion (Option 930A-19)

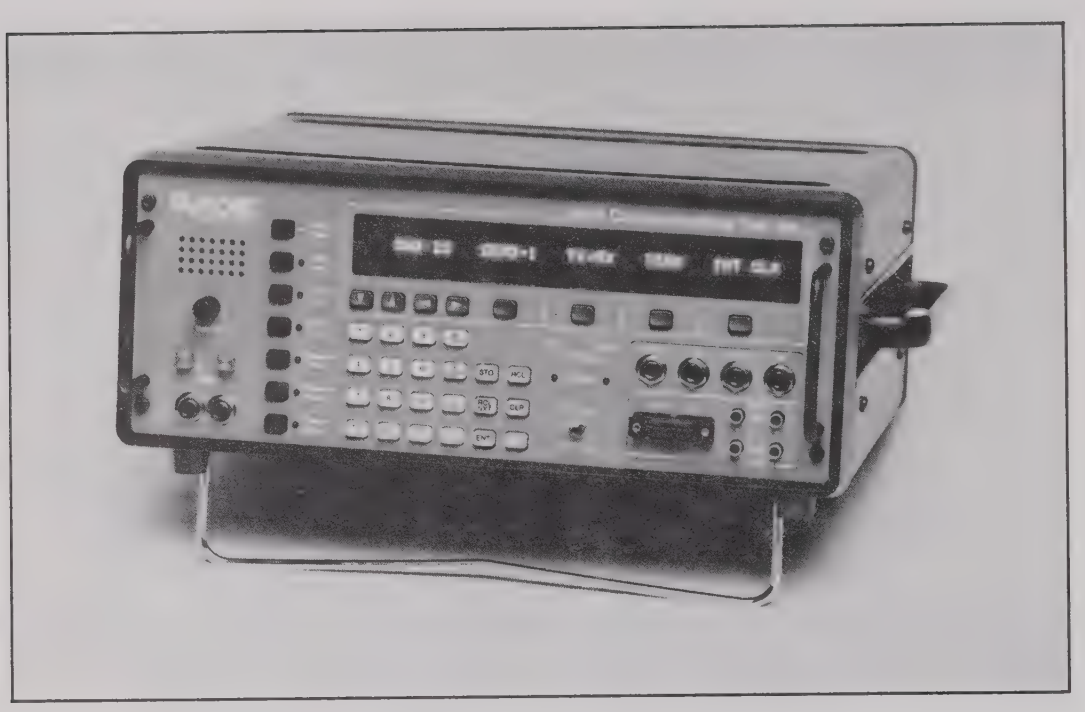
The signaling and supervision simulation capabilities of the Model 930A are:

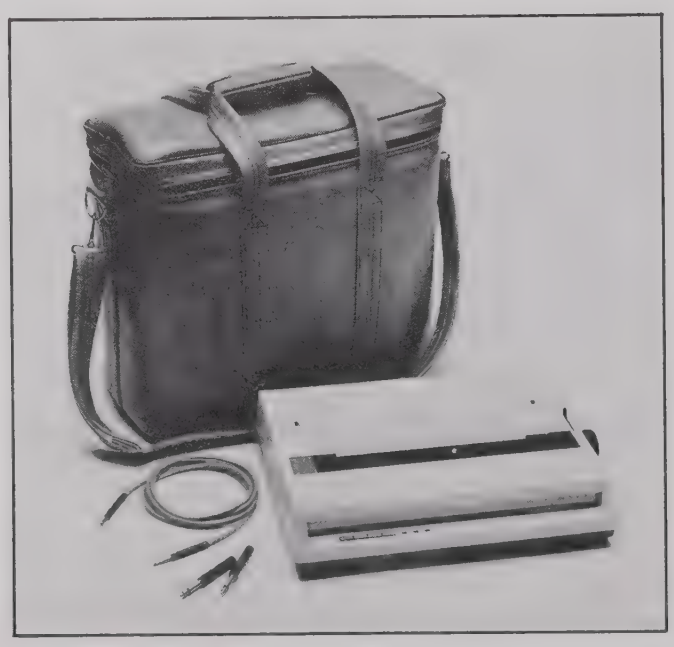
1. 2- and 4-wire Loop Start (Normal and Reverse)
2. Ground Start (Normal and Reverse)
3. E&M signaling Types I, II, III, IV and V
4. Wink Start
5. Multi-Wink/Multi-Stage (Feature Group D, TSPS, etc.)
6. Delay Dial
7. SX supervision
8. DP, DTMF, and MF signaling sender
9. DP, DTMF, and MF Receiver/Analyzer (Option 930A-01)
10. SF supervision (Option 930A-02)
11. T-1 (Robbed Bit signaling) (Option 930A-08E or -09E)
12. FXO/FXS supervision on PCM trunks (Option 930A-25)

The Model 930A can also establish the talk path condition for transmission testing and has the ability to hold circuits for testing.

The T-1 facility testing capabilities of the 930A are:

1. Send and Receive patterns for DS-0/DS-1 Bit Error Rate Testing (Option 930A-22)
2. Count Slips, BPVs, Frame Errors and Losses, CRC Errors (Option 930A-08E or -09E)
3. Provide detailed error history (Option 930A-22)
4. Measure T-1 voltage at the DSX (Option 930A-08E or -09E)
5. A, B, C & D Bit Timing (Option 930A-08E or -09E)





MODEL 930A AND ACCESSORIES
FIGURE 1-1

1-4 A WORD ABOUT SOFTKEY CONTROLLED TEST SETS

As you can see from glancing at Figure 1-1, the 930A front panel has push-buttons for everything. With all microprocessor controlled equipment, you have the advantage of placing a lot of functions into one compact package. You have to get used to using a single front panel to operate what, in the old days, was four or more separate instruments. In order to accomplish this feat, and still have a reasonably sized instrument, a bit of ingenuity is required. Most manufacturers, SAGE included, have chosen to use the **"softkey"** approach.

What this means is that the four unlabeled keys, directly below the display, and to the right of the arrow keys, change their definition with each new display. **The display above the key** at any particular time defines that keys function at that instant.

In the 930A, every attempt has been made to have the unit operate in a logical manner. For example, when you turn on the 930A, the first thing it does is power up to the last trunk type you selected. It wants to give you the opportunity to change to another trunk type. Since the 930A operates on so many different trunk types, and it can simulate either the office or subscriber ends of each type, this is a valid question. Also, the 930A sets many of its defaults, such as Transmission Level Points (TLP), depending on the trunk type you select.

The layout of the front panel is intended to be logical so the major functions (Trunk Type, Dial/Ring, etc.) are grouped separately from the Numeric Keypad and the Special Function keys. Once the desired function key has been pressed and the LED beside it lights, control within that function passes to the arrow keys and softkeys under the display.

If you keep this in mind it will make learning and using the 930A a bit easier. Just in case, there is a front panel **HELP** key which provides step-by-step prompts for operating each function (except the **OPTION MENU** Function key). The display will have a flashing cursor over the currently selected parameter for each step. If you want that particular choice you press the softkey under it. If you do not want it, you press the softkey under the choice you do want. The screen will advance to the next item for you to select, and so on, until the function has been set up. The display will then return to the function's main screen.

1-5 ACCESSORIES AVAILABLE

The following accessories are available:

1. 80 Column Dot Matrix Printer and Cable,
   SAGE P/N 9400-0001-01
2. Test Cord, bantam male to bantam male, 96 inches
   SAGE P/N 9400-0002-01
3. Adapter , 310 male to bantam female,
   SAGE P/N 9400-0003-01
4. Test Cord, 310 male to 310 male, 60 inches
   SAGE P/N 9400-0004-01
5. Test Cord, 310 male to alligator clip, 60 inches
   SAGE P/N 9400-0005-01
6. Test Cord, 310 male to bantam male, 96 inches
   SAGE P/N 9400-0006-01
7. Standard 19-inch rack mounting kit,
   SAGE P/N 9400-1001-01
8. Standard 23-inch rack mounting kit,
   SAGE P/N 9400-1002-01
9. Padded Vinyl Carrying Case,
   SAGE P/N 9400-1003-01
10. Industrial Grade Shipping Case,
    SAGE P/N 9400-1004-01
11. Front Panel Cover,
    SAGE P/N 9400-1005-01
12. Calibration Kit
    SAGE P/N 9400-0012-01

1-6 WARRANTY

Warranty information is listed on the inside of the front cover.

TABLE 1-1 *Specifications (con't)*

GENERAL

Impedances:	150, 600, 900, 1200 ohms and > 50 Kohms Bridging
Maximum DC Blocking:	160 VDC
Audio Bandwidth:	± 3.0 dB 300 Hz to 3.0 KHz
Audio Volume:	Adjustable by front panel control
Longitudinal Balance:	90 dB at 60 Hz
Receiver Return Loss:	> 30 dB 200 Hz to 5 KHz (600, 900, 1200 ohms) > 30 dB 800 Hz to 5 KHz (150 ohms)
Display:	40 character vacuum fluorescent plus 4 LED's for ON/OFF Hook status
AC Power Supply:	115 VAC ± 10%, 60 Hz
Operating Temperature:	0^{o} C to 50^{o} C
Storage Temperature:	- 40^{o} C to 70^{o} C
Dimensions:	5.79" H. x 14.33" W. x 14.25" D.
Weight:	16 to 18 lbs. depending upon options.

OPTIONS

MF/DTMF/DP RECEIVER AND ANALYZER (OPTION 930A-01)

MF AND DTMF

Input Level Range:	-25 dBm to 0 dBm
Accuracy:	± 0.2 dB
Resolution:	0.1 dB
Input Frequency Range:	± 10% of AT&T standard frequencies for MF and DTMF tones.
Accuracy:	± 0.1%
Resolution:	1 Hz
Input Tone ON/OFF Range:	35 msecs. to 250 msecs. Tone ON 35 msecs. to 250 msecs. Tone OFF
Accuracy:	± 5 msecs.
Resolution:	1 msecs.

TABLE 1-1 *Specifications (con't)*

DIAL PULSE (DP) RECEIVER AND ANALYZER (OPTION 930A-01)

PPS Range:	5 PPS to 30 PPS
Accuracy:	± 2% @ 10 PPS
Resolution:	0.1 PPS
% Break:	10% to 90%
Accuracy:	± 2% (25% to 75% break at 10 PPS)
Resolution:	0.1%
Interdigit Timing Range:	50 msecs. to 990 msecs.
Accuracy:	± 5 msecs.
Resolution:	1 msec.

SF SUPERVISION (OPTION 930A-02)

SF Oscillator:	2604 Hz, ± 1.0 Hz
Send Level:	-36 dBm0 On Hook, -13 dBm0 pulse
Receiver Sensitivity	-42 dBm0

PEAK TO AVERAGE RATIO (P/AR) (OPTION 930A-06)

Transmit Level Range:	0 dBm to -40 dBm
Resolution:	0.1 dB
Receive Level Range:	-40 dBm to +12 dBm
Resolution:	0.1 dB
P/AR Measurement Range:	0 to 120 P/AR units
Resolution:	1 P/AR unit
Accuracy:	± 1 P/AR unit

3-LEVEL IMPULSE NOISE (OPTION 930A-07)

Weighting Filter:	C-Notch
Threshold Range:	30 dBrnC to 106 dBrnC
Accuracy:	± 1.0 dB
Threshold Spread:	2, 4, 6, or 8 dB steps
Timer:	1 min. to 99 mins. or continuous
Counter Capacity:	0 to 9999 for LO, MD and HI.
Measurements Range:	7 to 99 measurements per second.

TABLE 1-1 *Specifications (con't)*

Receiver Input Level:	+10 dBm to -40 dBm (Metallic) 0.0 dBm to -40 dBm (PCM)
Distortion Measurement range:	+9000, -3000 μseconds
Accuracy:	± 10μs 604 Hz to 3504 Hz ± 30μs 304 Hz to 603 Hz

INTERMODULATION DISTORTION (OPTION 930A-20) *

Transmitter Spectrum:	Four equal level tones (857, 863, 1372 and 1388 Hz)
Harmonic distortion:	>35 dB below tone level
Transmitter Level Range:	0 dBm to -40 dBm RMS (Metallic) -6 dBm to -40 dBm RMS (PCM)
Accuracy:	± 1 dB
Receiver Input Level:	0 dBm to -40 dBm RMS (Metallic) -6 dBm to -40 dBm RMS (PCM)
Distortion Products:	2nd Order centered at 520 and 2240 Hz 3rd Order centered at 1900 Hz
Distortion Range:	10 dB to 70 dB below signal-2nd Order 10 dB to 70 dB below signal-3rd Order
Resolution:	1 dB
Accuracy:	± 1 dB
Signal to Noise Test:	Removes Low Tone pair and increases level of remaining tone pair by 3 dB.

* Licensed under Hekimian Laboratories, Inc. Patent No. 3, 862, 380

TABLE 1-1 *Specifications (con't)*

DS-0/DS-1 BIT ERROR RATE TESTING (OPTION 930A-22)

DS-1 BERT SPECIFICATIONS

Input:	See Option 930A-08E/09E specifications
Output:	See Option 930A-08E/09E specifications
Framing:	Patterns may be framed (D4 or ESF) or unframed.
Test Patterns:	Pseudo-random bit sequences (PRBS) of the following lengths may be sent and received: 2^9-1 (511) 2^{11}-1 (2047) 2^{15}-1 2^{20}-1 QRSS (2^{20}-1 with 14 zero suppression) 2^{23}-1
Stress Patterns:	3 in 24 bits (100010001000000000000000) 1 : 7 bits (10000000) 1 : 1 bits (1010) All 1's 55 OCTETS (440 bit pattern for Multiplexer Testing)
User-Defined Patterns:	User may input any bit sequence length from 1 to 24 bits (even numbers from 18 to 24) Pattern will continuously repeat
Loopback Codes:	Send and Receive CSU loop codes: Loop Up= 10000 continuous for 8 seconds Loop Down= 100 continuous Other Loop codes can be sent and received by editing the above patterns.
Error Injection:	Inject single logic errors, bipolar violations, frame errors (D4 mode) or CRC errors (ESF mode).

TABLE 1-1 *Specifications (con't)*

DS-1 BERT SPECIFICATIONS (Continued)

PRBS Receiver Sync:	128 consecutive error-free bits must be received to achieve synchronization. BER of greater than 10^{-1} for 320 milliseconds causes sync loss and resync attempt.
Pattern Sync:	386 consecutive bits with less than 10^{-2} error rate must be received to achieve pattern sync. BER of greater than 10^{-2} for 2 milliseconds causes sync loss and resync attempt.
Measurements:	Measures and displays: Bit (Logic) Errors, Bit Error Rate, Bit Slips, Bipolar Violations (BPV), Frame Errors, Frame Losses, Frame Slips, CRC Errors (ESF mode), Errored Seconds, % Errored Seconds, Error Free Seconds, % Error Free Seconds, Severely Errored Seconds, % Severely Errored Seconds, Failed Seconds, % Failed Seconds, Unavailable Seconds, % Unavailable Seconds, % Availability, No Sync, Test Length, Clock Time/Date, Elapsed Time.
Test Length:	Timed or continuous
Timed Test Length:	15 minutes, 1 hour or 24 Hours.

DS-0 BERT SPECIFICATIONS

56 KBps Mode:	Selected when 930A is set to "Robbed Bit" signaling. Least significant bit of channel under test is always set to 1.
64 KBps Mode:	Selected when 930A is set to either B8ZS (Clear Channel) line code or CCIS signaling.
Test Patterns:	Pseudo-random bit sequences (PRBS) of the following lengths may be sent and received: 2^9-1 (511) 2^{11}-1 (2047)

Stress Patterns:	1 : 7 bits (10000000) 1 : 1 bits (1010) All 1's All 0's
User-Defined Patterns:	User may input any bit sequence length from 1 to 8 bits Pattern will continuously repeat
Loopback Codes:	Send and Receive CSU/DSU/OCU loop codes in 56 KBps mode. LSB of selected channel byte is always set to 0. Cannot be used with switched 56 KBps channels using robbed bit signaling.
Error Counters:	All DS-1 errors (i.e., BPV errors, frame errors, CRC errors, Slips, etc.) are recorded for the entire DS-1. Bit Errors and Bit Error Rate are calculated on the received DS-0 channel selected. CCITT G.821 Error statistics are based on the bit errors of the selected DS-0 channel received.
Error Injection:	Inject single bit errors.

2-4 OPERATING ENVIRONMENT

This instrument may be operated in temperatures from 0 degrees C to 50 degrees C (+ 32 degrees F to + 122 degrees F). The instrument will operate in environments with humidity from 10 to 90% relative humidity, non-condensing, at +40 degrees C (104 degrees F).

2-5 STORAGE AND SHIPMENT

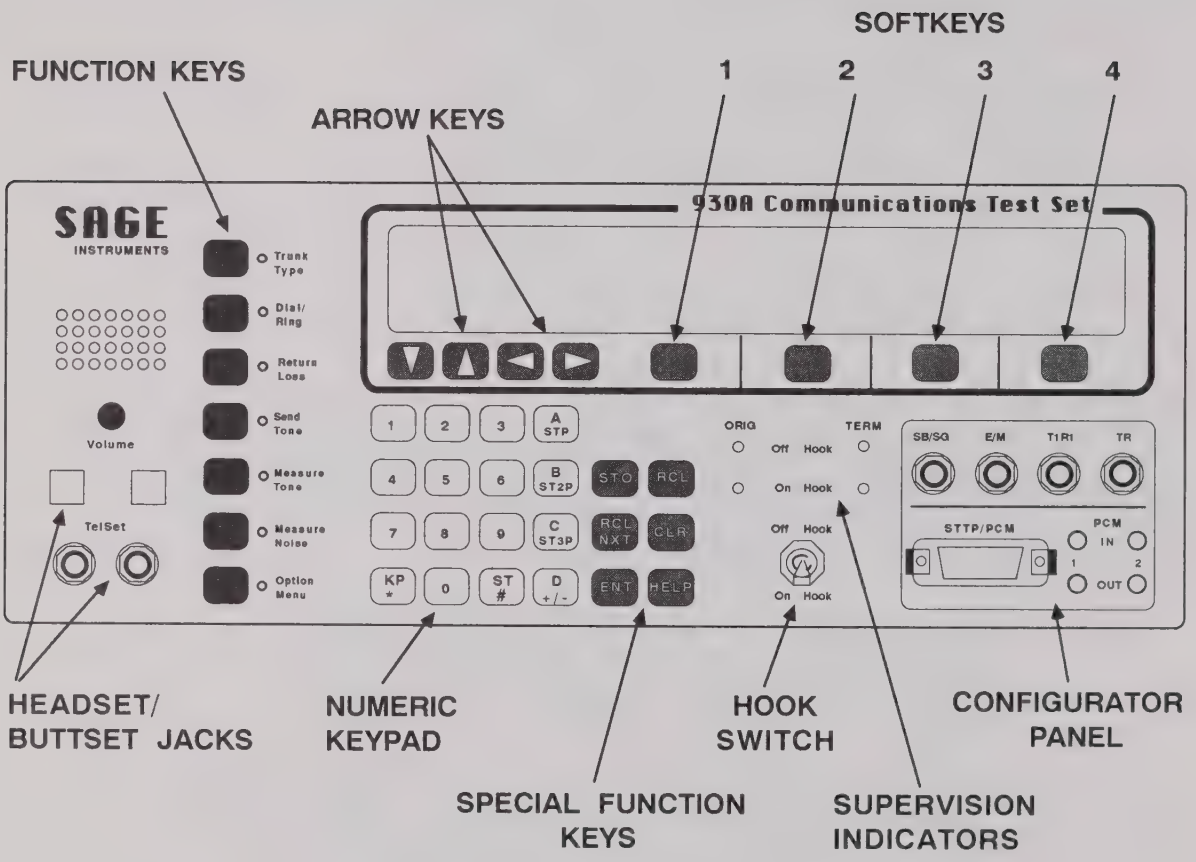
The instrument may be stored and shipped within the following environmental limits:

* Temperature -40 to +70 degrees C
* Humidity Up to 90% Relative @ +65 degrees C

If possible, retain the original shipping container and packing materials. If you should ever have to return your 930A to SAGE, the original packaging will protect the instrument. In the event that the original container is no longer available, the following general instructions should be used for repackaging the instrument with commercially available materials.

1. Include return address, serial number, returned material authorization number, and the name of a technical contact when returning instrument for service.
2. Use a double-walled carton of at least 350 pound test material. Dimensions must be 21"L.x19.5"W.x14.25"H. to provide space for shock-absorbing material.
3. Use a 3-4 inch layer of shock absorbing foam material (**Do not use "popcorn" foam**) on all sides, top, and bottom of the instrument. Protect the front panel with cardboard.
4. Seal the container securely.
5. Mark the container **FRAGILE** to ensure careful handling. Write the **RMA** number under the address.
6. Refer to the instrument model number and serial number in any correspondence.

The instrument warranty will be voided if an instrument is returned and found to be improperly packaged.



MODEL 930A FRONT PANEL
FIGURE 2-2

SECTION III
OPERATION

3-1 INTRODUCTION

This section of the manual provides you with information on the **operation** of the Model 930A **standard features.** These test primarily on analog communication networks. The Model 930A is a general purpose test set which has been designed to test Equal Access (Feature Group D), T-1, PBX, Data, Toll, Message, and Private Line trunks. The Model 930A is particularly well-suited to testing at the **DEMARC**, or Point of Interface (**POI**).

3-2 GETTING THE 930A TO DO WHAT YOU WANT

To begin, the 930A operates in a logical manner. The steps you need to follow are actually quite few. The operation always proceeds as follows:

1. Turn unit on.
2. Select Trunk Type, set direction (Office or Customer), set interface (2W 900 ohm, 4W 600 ohm, etc.), and select Terminated or Bridged operation, using softkeys.
3. Select desired test function such as Dial/Ring, Send Tone, Measure Noise, or optional function.
4. Use **HELP** and/or softkeys to set-up test functions if required.
5. Use front panel Hook Switch to seize the trunk, draw dial tone and hold the circuit up during test.
6. Use Numeric Keypad as required to dial out, etc.

You will find that the 930A retains the last settings you input so that it is only necessary to set functions up once in most cases. You will also learn later that every front panel setting can be stored in one of 39 memory locations for future recall.

For now, familiarize yourself with the locations of the front panel keys and press them to see what they do in various screens. In particular, see what the arrow keys and softkeys do. It Is probably a good idea not to connect the 930A to the actual trunk under test until after you are more familiar with its operation.

If you have the T-Carrier interface option installed in your 930A as most users do, you will find its operation covered in Section VI of this manual.

In the meantime, learn the functions of the various keys while in an analog trunk type such as **LOOP START** or **E&M.** Then the 930A won't keep beeping at you, and complaining that it doesn't have any **PCM**, when you haven't even connected it to a T-1. The display flashing has been slowed down in recent software versions and pressing any front panel key adds another 4 seconds to the interval between beeps so that you can set up the 930A in peace.

You can't hurt the 930A by pushing buttons, although we make no claims regarding what you may do to the trunk under test, and the traffic on it, through such actions. In many cases, precautions have been taken to prevent you from causing service interruptions through inadvertently pressing the wrong keys. The 930A either refuses to do what was asked and responds with a message, or simply does nothing.

Remember, the definition of a softkey changes with the display above it. They operate in several ways, but are at least consistent. That is, pressing a softkey will do one of the following things:

1. Nothing-The softkey you pressed is not active
2. Change to another displayed value (i.e., from **TERM** to **BRIDGE**)
3. Move the cursor or highlight over a parameter to be changed (i.e., pressing softkey under the level in the **SEND TONE** menu moves the flashing cursor from frequency to level so it can be changed).
4. Cause other parts of the display to change as well (i.e., changing from 2-wire to 4-wire mode on an analog trunk causes the 930A to go from Terminated to Bridged operation if it is not already there).

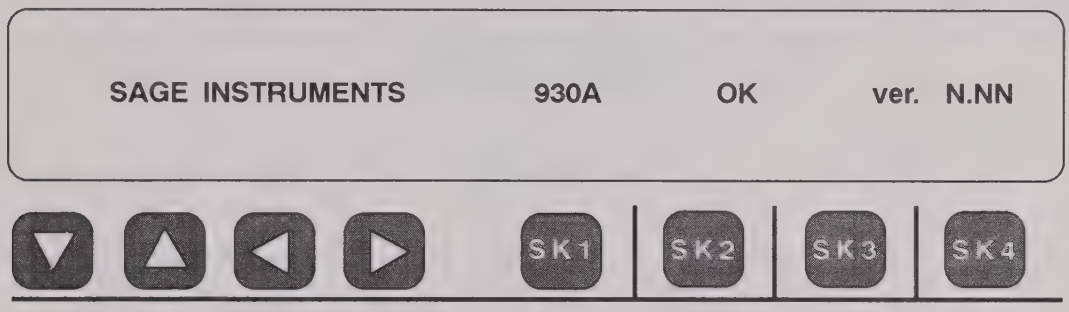
Pressing a softkey usually amounts to nothing more than scrolling through the available choices under the displayed heading. In most instances, you will be returned to where you started, if you press the key enough times.

Data entry on the Model 930A is accomplished in one of three ways: Numeric entry using the Numeric Keypad; Menu entry using the Softkeys; or incremental entry using the Cursor or Arrow Keys.

The rest of Section III is organized after the six steps outlined on page 3-1 and proceeds from the initial power-on stage, through the set-up, and use of the various standard tests, in the order in which they appear.

3-2.1 WHEN FIRST TURNING ON THE 930A

Once you have read Section II of this manual, you are prepared to turn on the Model 930A. When first switched on, the 930A will run through a PROM check and then briefly display the following:



where "N.NN" is the version of software present in the unit. Later you will learn how to find the software version without turning the unit off and on. Note the condition of the eleven LED's on the front panel. If a normal **"Warm Boot"** has occurred, one LED will be lit or flashing. If an error has been detected by the built-in self test, all of the LED's will be lit and the unit will perform a **"Cold-Boot."** This is an abnormal condition indicating a possible malfunction of the test set. Turn the 930A off and perform a **"Cold-Boot"** as described in Paragraph 3-2.2. Normally, the 930A will **"Warm-Boot"** and power-up to the last settings before it was turned off.

3-2.2 HOW TO "COLD-BOOT" THE 930A, OR WHAT TO DO IN CASE IT DOES NOT SEEM TO WORK PROPERLY

The first thing to realize about the 930A is that it reacts in many ways like a computer because, after all, it has an on-board processor. So, just like the big guys, it can occasionally lose its mind, wander off somewhere, act crazy, or be driven mad by its owner. **Cold booting the 930A** is similar to pressing CNTRL-ALT-DEL on an IBM PC. It gets the processors attention, clears out the memory, restores the factory defaults, and permits normal operation to resume. Think of it as the electronic equivalent of an Ex-Lax.

There are other times when this procedure is beneficial, aside from instances where the operation of the 930A is suspect. You may want to restore all the factory default settings if others have used your 930A and changed your settings. You may, from time to time, receive **FREE** software upgrades to your 930A. After installing the new EPROMs, it is necessary to

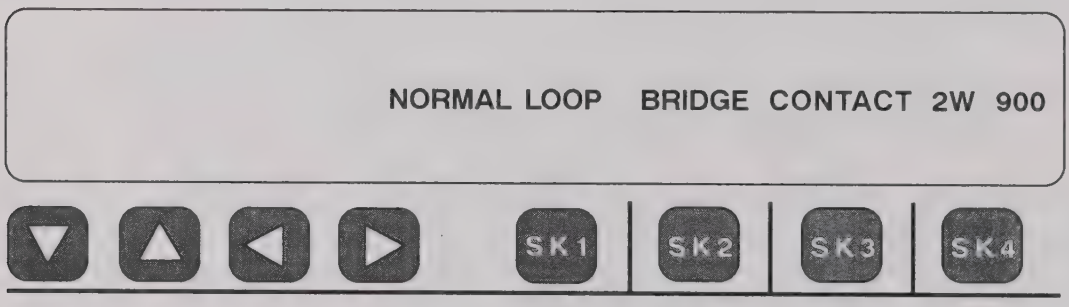
perform a **cold boot** to initialize the software.

There are two types of "Cold-Boots" you can perform on the 930A. One is a complete **"hardware cold-boot"** and the other is a **"software cold-boot."** The latter has been added for the convenience of persons writing remote control software and can be found in Option Menu 92 which is discussed later. For now, concern yourself with how to do the hardware cold-boot. This is the type you will need to perform when changing software.

All that is necessary is to follow these steps:

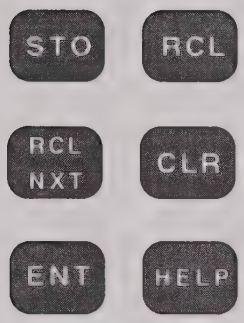
1. Turn off the 930A
2. Hold down the **TRUNK TYPE** (or any other) Function key.
3. Keep the function key held down, turn on the 930A but do not release the function key until the display has scrolled all the way across the screen, and the 930A has started its PROM check.

A successful cold-boot will erase any previously stored settings, or test results, and restore factory defaults to all menus. The 930A will, after it completes its PROM test, come up in its default Trunk Type display which is shown below:



NOTE:
If you have purchased your 930A without an analog interface (T-1 only), then your default Trunk Type is PCM.

If the 930A does not come up to the default Trunk Type, then you did not get a cold-boot. Should you encounter any difficulty, please do not hesitate to call SAGE Customer Service at (408) 761-1000.



3-3.2.5 HOW TO ENTER AND CLEAR DATA

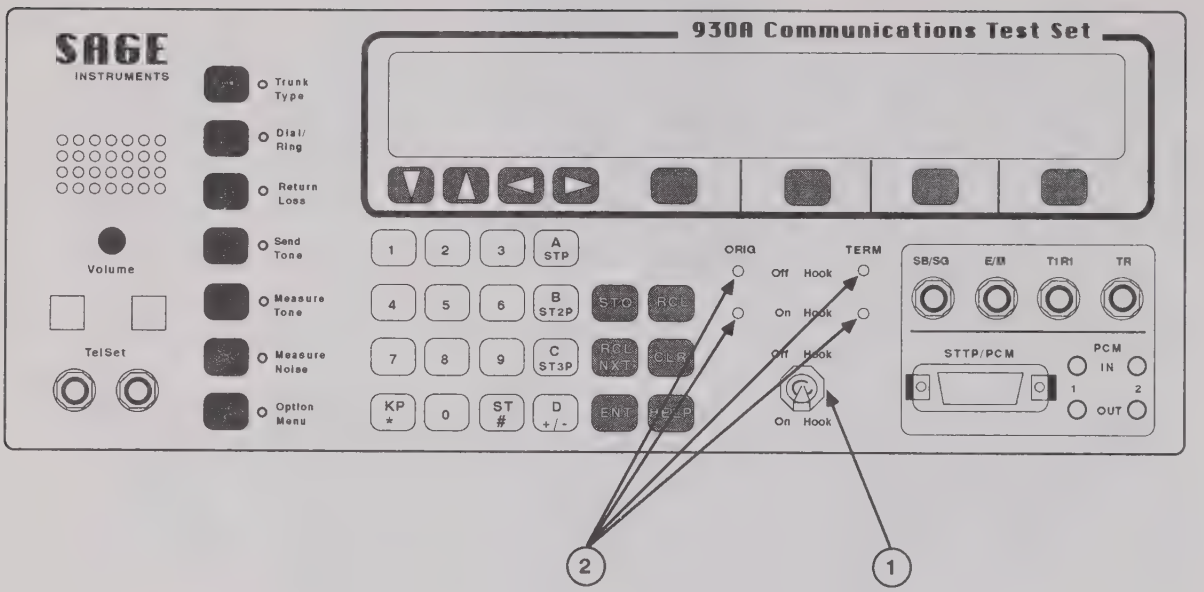
The **ENTER** key operates exactly like a calculator functions. Once the correct numeric data has been input for a particular test or program, all you do is press **ENT** and the data is accepted. In some cases, you cannot advance to the next operation until you have completed your data entry by pressing the **ENTER** key. Pressing **ENTER** will also cause a print out of the current display if a printer is connected to the 930A in Printer remote mode.

The **CLEAR** key is used to clear or initialize sequences and allow new entries to be made. It is **not** used to clear a numeric value to zero. This is done by simply entering a zero. The **CLR** key is used to clear sequences of variable length, such as a string of digits to be outpulsed in the **DIAL/RING** mode.

The only functions which require the use of the **CLEAR** key, and which are covered in this manual, are Dial/Ring (Section 3-5), Send Digit Sequences (Section 3-10.3), Digit Receiver (Section 4-2) and DS-0/DS-1 Errors (Sections 6-6, 6-17 and 6-18).

3-3.2.6 HOW TO USE THE HELP KEY

The **HELP** key is provided to assist you in operating the Model 930A. Any time you get stuck, pressing the **HELP** key provides a series of screens which generally lead you, step-by-step, through the function. **Remember** that when you press the **HELP** key, the **softkeys** are controlling each selection. So, as each screen appears, you must choose the correct parameter for your test by pressing the **softkey** directly under the displayed value, or item, you want. **HELP** is available in each function from **TRUNK TYPE** down to **MEASURE NOISE**. **HELP** is **not** available for the individual functions under the **OPTION MENU** function key. This is due to the large number of functions under this key and the limitations on memory.



To use the Hook Switch:

1. The Hook Switch controls whether the 930A is **"On Hook"** or **"Off Hook."** On 2- and 4-wire analog trunks it also engages the holding coils. (To outpulse digits, send tones, etc., the 930A must be **Off Hook** in most cases.)*
2. The Supervision LEDs show the status of the Originate and Terminate ends of the circuit.

* In some Trunk Types and directions (such as Loop Contact), the 930A must be **"Off Hook"** to send tones and outpulse digits.

HOW TO USE THE HOOK SWITCH
FIGURE 3-5

3-4.4 HOW TO CONNECT TEST CORDS TO THE 930A

Figure 3-7 shows the connection points for the various test cords which may be used with the 930A. The universal configurator is shown because it has the most varied connections.

Several types of configurator panels are available depending upon the options installed in the 930A. Refer back to Figure 2-3, page 2-6 for a description. Although the jacks may be located in different positions, a jack labeled **"TR"** or **"PCM IN 1"** for example, is connected and used the same on all configurator panels.

A 2-wire Loop Start, Ground Start, or Reverse Battery trunk is connected to the 930A at the type 310 jack labeled **"TR"**.

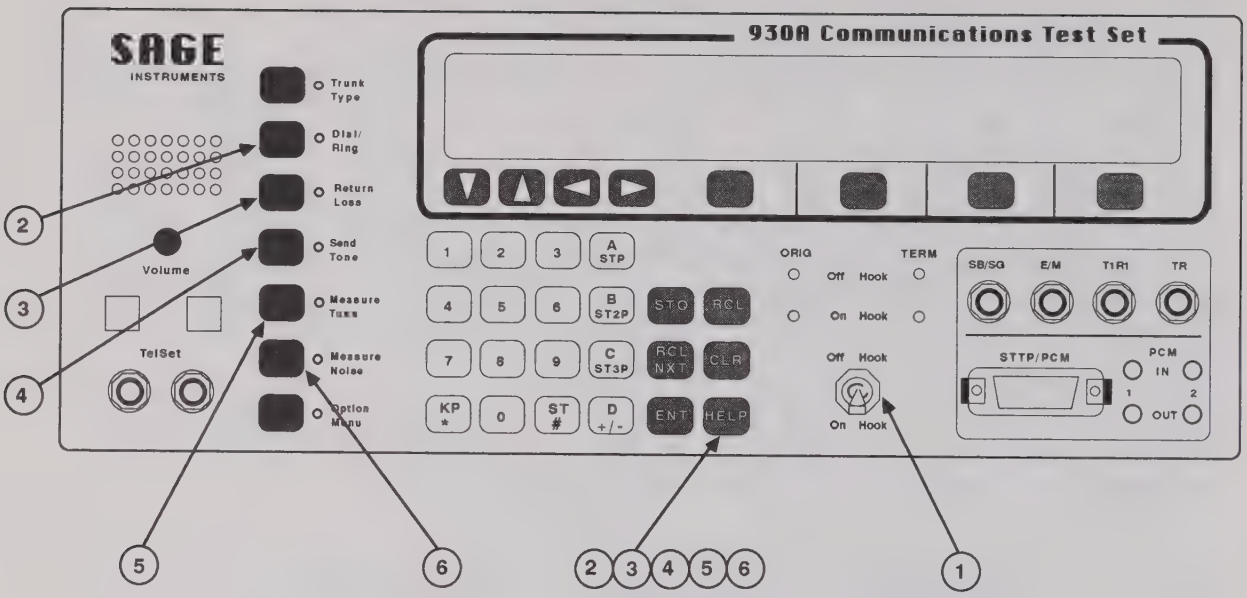
A 4-wire trunk requires connections to the type 310 jacks labeled **"TR"** and **"T1R1"**. If the trunk is an **E&M** trunk, the **E&M** lead test cord must be connected to the type 310 jack labeled **"E/M"** for Type I. If **E&M Types II** through **IV** are being tested, the signal battery/signal ground leads must be connected to the type 310 jack labeled **"SB/SG"**.

If a T-1 (DS-1) carrier circuit is to be tested, the tiny telephone (bantam) jacks labeled **"PCM IN 1"** and **"PCM OUT 1"** are used for single direction testing (Option 930A-08E). **For dual direction drop and insert** testing, **"PCM IN 2"** and **"PCM OUT 2"** will also be used. This requires Option 930A-09E to be installed. The **310 A/P** configurator uses type 310 jacks instead of bantam jacks, but the function is the same.

PCM trunk testing diagrams are shown in Section VI, Figures 6-2 through 6-12.

If the 930A is to be used to directly interface to a No. 1/1A ESS switching machine at the local trunk test panel, then the Sage Model 114A adapter must be wired into the trunk test panel. The 930A is connected to the 114A by a special cable using the 15 pin connector labeled "**STTP/PCM**".

To place a call using the 930A, or to talk over the trunk under test, a telephone handset, or lineman's butt-in set, can be connected to the Tel-Set jacks, or the butt-in terminals, located in the lower left hand corner of the front panel.



Some commonly performed tests are:

1. After selecting the correct trunk type, place the **Hook Switch** in the **OFF HOOK** position to draw Dial Tone.
2. To place a call, press the **DIAL/RING** Function key. Press the **HELP** key if unsure of operation.
3. To measure Return Loss, press the **RETURN LOSS** Function key. Press the **HELP** key if unsure of operation.
4. To send a frequency at a specific level, press the **SEND TONE** Function key. Press **HELP** if unsure of operation.
5. To measure the frequency and level of a received tone, press the **MEASURE TONE** Function key.
6. To measure the noise level on a circuit, press the **MEASURE NOISE** Function key. Press the **HELP** key if unsure of operation.

COMMONLY PERFORMED TESTS
FIGURE 3-8

3-4.5 HOW TO FIND AND USE THE 930A's BASIC TEST FUNCTIONS

The six basic test functions built into all Model 930A's are controlled by the seven black keys arranged in a column along the left edge of the front panel of the Model 930A as shown in Figure 3-8. There is one key for each of the six basic test functions, and an "Option Menu" key for additional functions and future expansion of capabilities. The six basic test functions and the sections in which they are covered are:

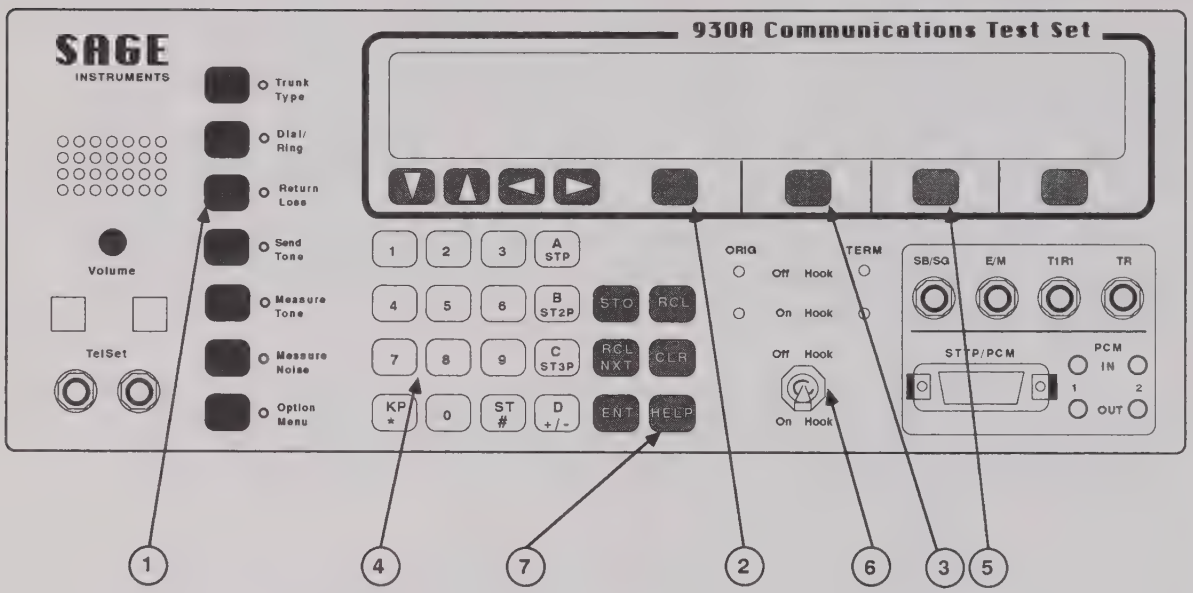
Trunk Type	(Section 3-4)
Dial/ Ring	(Section 3-5)
Return Loss	(Section 3-6)
Send Tone	(Section 3-7)
Measure Tone	(Section 3-8)
Measure Noise	(Section 3-9)

Seventeen additional functions are standard with the Model 930A.

Option Menu	(Section 3-10)

Some of these additional functions are: Modify Send Digits, Send Digit Sequences, DC Volt/Amp Meter, Supervision Threshold Adjustment, Supervision Monitor, Wink Timing, Frequency Sweep, Adjust TLP, Beep On Error, Dial-Up Testline, and Dial-Up Sweep. These functions are described in detail in Section 3-10.

The operation of purchased options is covered in Sections IV, V and VI. A guide to locating specific test options is found on pages 4-3 and 4-4.



To Measure Return Loss:

1. Press the **RETURN LOSS** Function key.
2. Press Softkey 1 to select **ERL, SRL-LO, SRL-HI,** or Sinewave Return Loss measurement.
3. Press Softkey 2 to send the momentary Echo Suppressor disable tone (2125 Hz) prior to testing.
4. Use the numeric keypad to enter any other disable tone (2000 to 2250 Hz range), or to enter tones for Sinewave (**OSC**) Return Loss.
5. Press Softkey 3, if required, to measure and enter the Trans-Hybrid Loss correction.
6. Ensure that the 930A is **OFF HOOK** when measuring Return Loss.
7. Press the **HELP** key if unsure of operation or set-up procedure.

MEASURING RETURN LOSS
FIGURE 3-10

3-10 FINDING WHAT YOU WANT UNDER THE OPTION MENU KEY

The good part about the **OPTION MENU** key is, it permits the capabilities of the 930A to be expanded without replacing the front panel. The bad news is, multiple functions are located under a single key. Figure 3-14 explains how to select a function under the **OPTION MENU** key. The following is a list of the Menu Options which come standard with all 930A's. A complete listing of all Menu Options (standard plus optional) is listed in Table 4-1 on pages 4-3 and 4-4.

TABLE 3-1
STANDARD MENU OPTION LOCATIONS

MENU OPTION NUMBER		DESCRIPTION	SECTION
OPTION NUMBER:	1	MODIFY DIAL/RING	3-10.2
OPTION NUMBER:	2	SEND DIGIT SEQUENCES	3-10.3
OPTION NUMBER:	6	DC VOLT/AMP METER	3-10.4
OPTION NUMBER:	7	SUPERVISION THRESHOLDS	3-10.5
OPTION NUMBER:	8	SUPERVISION MONITOR	3-10.6
OPTION NUMBER:	9	WINK TIMING	3-10.7
OPTION NUMBER:	10	FREQUENCY SWEEP	3-10.8
OPTION NUMBER:	15	BEEP ON ERROR	3-10.9
OPTION NUMBER:	30	ADJUST TLP	3-10.10
OPTION NUMBER:	31	SEND HOOK FLASH	3-10.11
OPTION NUMBER:	32	DIAL-UP TESTLINE	3-10.12
OPTION NUMBER:	33	DIAL-UP SWEEP	3-10.13
OPTION NUMBER:	35	DUAL-TONE SENDER	3-10.20
OPTION NUMBER:	65	GND-ST COIN PHONE	3-10.21
OPTION NUMBER:	90	DSP MEMORY TEST	3-10.14
OPTION NUMBER:	91	SOFTWARE VERSION	3-10.15
OPTION NUMBER:	92	SOFTWARE COLD-BOOT	3-10.16
OPTION NUMBER:	93	TEST DISPLAY	3-10.17
OPTION NUMBER:	94	LIST OPTIONS	3-10.18
OPTION NUMBER:	95	DRY CIRCUIT	3-10.19

Menu Option 94 is useful if you want to find out what **purchased** options are installed in your 930A.

All other menu numbers up to 98 are either used by purchased options or are reserved for future expansion. They may be labeled if you have purchased the corresponding option or they may say "Not Installed."

3-10.1 HOW TO GET INTO THE MENU ONCE YOU FIND IT

There are two ways you can get into the Menu Option of your choice. After pressing the **OPTION MENU** key you will see the last selected menu. It could be, for example, **OPTION NUMBER: 6 DC VOLT/AMP METER**. Suppose you want to adjust the Transmission Level Point (**TLP**) of the receiver. You will need to get to Menu Option 30. **One method** is to enter the number 30 using the keypad and press **ENTER**. This gets you right inside Menu 30 and you can start adjusting. **The other way** to do this is to page upward through the menus using the **UP** Arrow key (or **DOWN** Arrow key as appropriate). When you get to Option Number 30 this way, you will still be on the outside. In order to get inside the menu, you simply press any softkey (**SK1, SK2, SK3, or SK4**) under the display and this will get you inside the menu. This procedure is true for all Menu Options, whether they are standard or optional.

You can get out of any of the Menu Options by pressing the **OPTION MENU** key, or any of the other 6 function keys, as many times as necessary. In many cases, one of the softkeys inside the Menu Option will be labeled **EXIT**, and pressing this softkey will have the same effect. **Remember** that you enter a Menu Option from the outside by pressing any softkey and you can back out of any menu by pressing the **OPTION MENU** key.

NOTE:

The option numbers for the **OPTION MENU** functions should not be confused with the order numbers of purchased options.

NOTE: To store the parameters which have been set up in a Menu Option, it is necessary to exit from that option. To do this, press the **OPTION MENU** key as many times as necessary to get outside, then press the **STORE** key and enter the desired storage location number (01 to 39). The only exception to this is **Option Number 1: MODIFY DIAL/RING**. This is explained in greater detail in Section 3-10.2.

The functions of these Menu Options and their operation is described in Sections 3-10.2 to 3-10.21. This manual covers the function and operation of the purchased options, as they relate to the **OPTION MENU**, in Sections IV, V and VI.

3-10.3 HOW TO BUILD A CALL SEQUENCE (MENU OPTION 2)

There will be times when you will want to send more than one phone number in sequence (Feature Group D, TSPS, etc.), or send a very long string of digits (up to 72 digits long), or continuously send a sequence of digits over and over.

Menu Option Number 2: **SEND DIGIT SEQUENCES** is the function which allows you to do these things. It operates in conjunction with the **DIAL/RING** function and the **STORE** function. Sections 3-3.2.1, 3-5, and 3-5.2 describe the details.

The procedure starts with entering the telephone numbers you want to send one at a time in the **DIAL/RING** function. You store each of these strings (for example 4087611000, 5551212, etc.) one at a time in any of the 39 registers (01 to 39). You then select Option Number 2, enter the menu, and input the storage location numbers instead of the phone numbers. This sounds a bit complicated but it is really easy once you have gone through the steps, or have seen it done.

Rather than go through details it is better to look at some examples. The following examples will show you how to send a multi-wink sequence such as a Feature Group D, how to send a simple wink start sequence, and how to send up to a 72 digit long string.

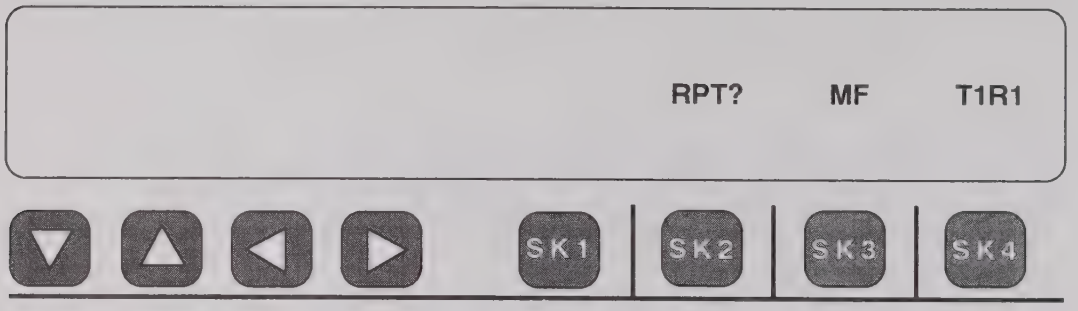
3-10.3.1 HOW TO BUILD A FEATURE GROUP D SEQUENCE IN THE 930A

To build a Feature Group D (Equal Access) call from a Bell Operating Company (BOC) switch to an Interconnect Carrier (IC) through an Access Tandem switch, do the following:

Press the DIAL/RING O **Dial/ Ring** function key.

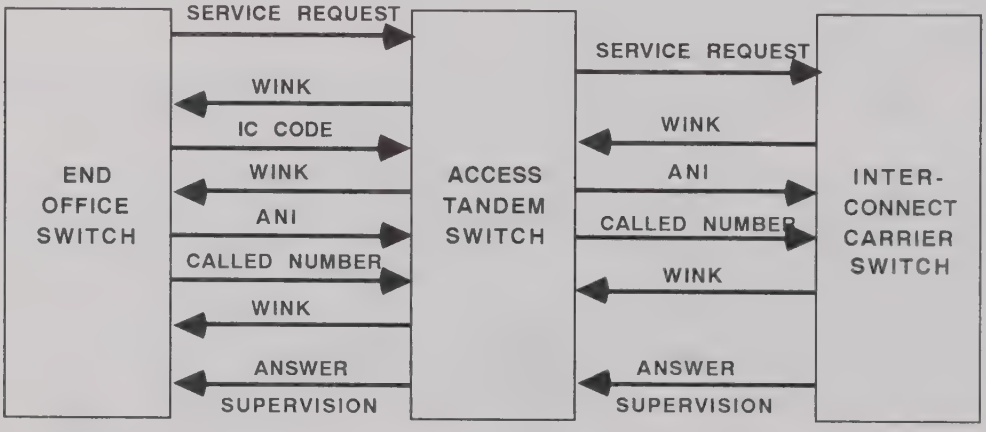
If no sequence has previously been entered, the display will come up blank. Normally, the last number dialed will be showing. Before beginning any data entry you should press the **CLEAR** key to remove any existing sequence from the display.

If there is no other sequence displayed, or after you have pressed the **CLEAR** key, you will see the display below.



If you do not come up into **MF** digits when you enter **DIAL/RING**, press Softkey 3 until **MF** is displayed.

Basically, there are two types of equal access sequences. The 3-stage sequence is found on the input side to the Access Tandem. The 2-stage is found on the output from the Access Tandem toward the Interconnect Carrier. Both are Wink Start trunk calls and the only difference is that the 3-stage includes the Interconnect Carrier's identity code in addition to the calling number (**ANI**) and the called number.

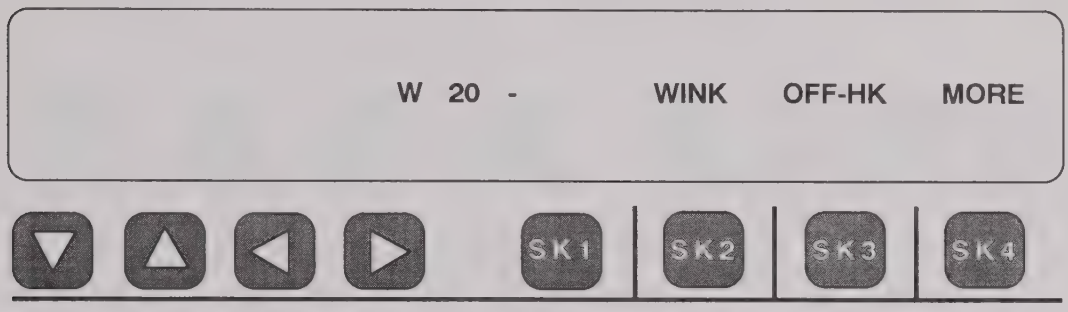


EQUAL ACCESS CALL PROGRESSION DIAGRAM
FIGURE 3-15

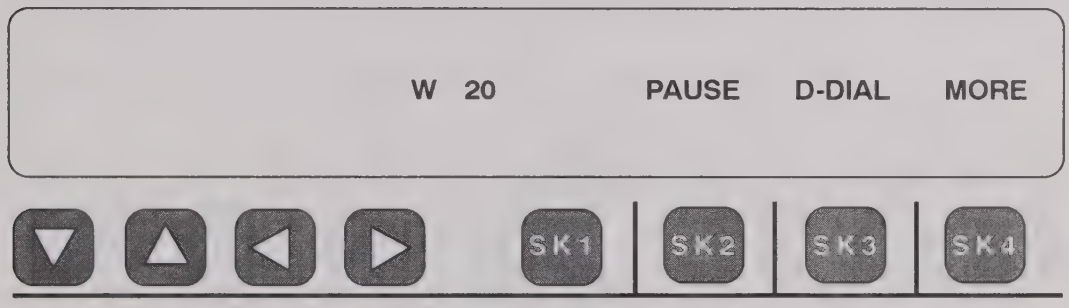
The 3-stage call has the form:

WINK IC CODE WINK CALLING # CALLED # WINK

From this menu you can enter the Pause by pressing Softkey 2 (under **PAUSE**) and the 930A display will become:

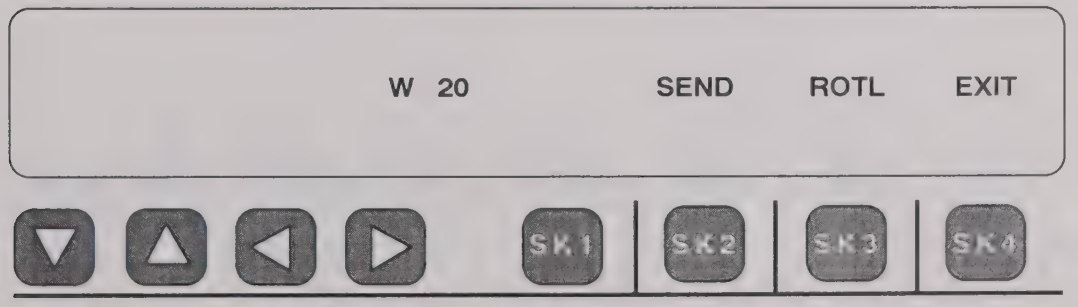


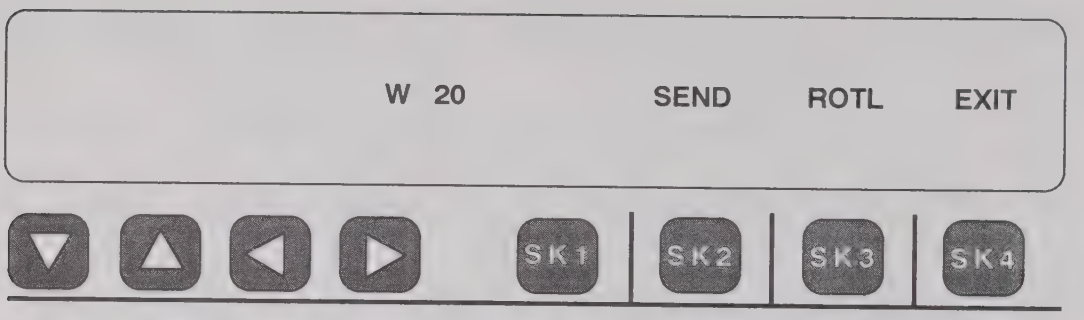
The digits stored in location **20** would be sent after going Off-Hook and receiving a wink. The 930A would then pause for one second after outpulsing.



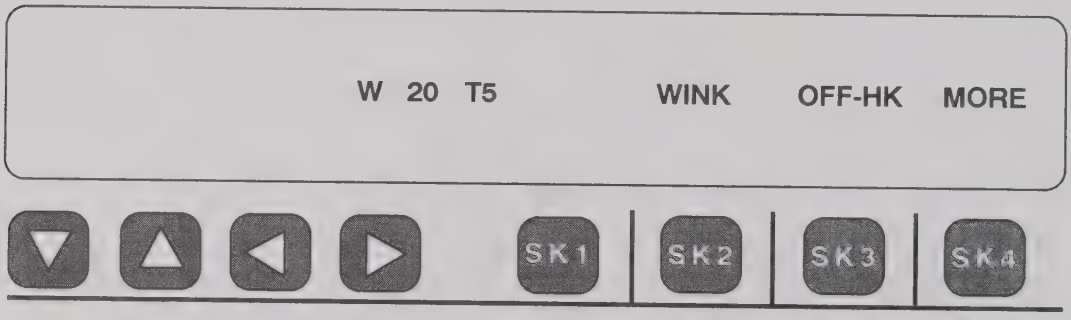
Instead of entering a **PAUSE**, a **DELAY-DIAL** event could be inserted by pressing Softkey 3.

Pressing Softkey 4 (under **MORE**) again, instead of entering a pause or delay-dial, would bring up the following choices:





Pressing Softkey 2 (under **SEND**) enables sending the sequence without first going **OFF HOOK**. **Pressing Softkey 3** (under **ROTL**) causes the 930A to act as a Remote Office Test Line (ROTL)/Near End Responder at the end of the sequence. Purchased Options 930A-01 and -12 are required for this to function. The display in this case looks like:



When the 930A goes OFF-HOOK, the number of the far-end test line will be outpulsed after the Wink is received. When the call completes, and the Test Line answers with the Test Progress Tones, the 930A will begin testing. The results of the 2-way measurements will be displayed. The results are stored in memory and you can review them in Menu Option 26. The operation of the ROTL/Responder option (Option 930A-12) is explained in greater detail in Section 4-6.2.1 since it is a purchased option.

3-10.4 HOW TO USE THE DC VOLT/AMP METER (MENU OPTION 6)

Menu Option 6: **DC VOLT/AMP METER** provides you with a DC voltage and current measuring capability on metallic (analog) trunks. This function is most useful for determining the levels of supervision voltages and currents on a loop.

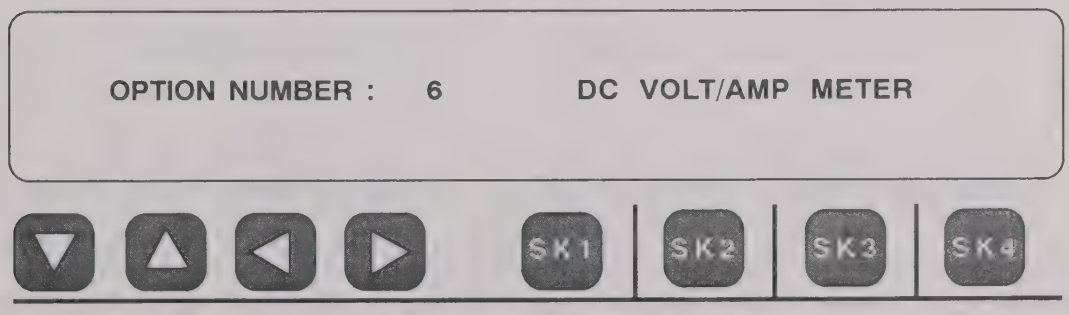
You can measure the DC voltage from Tip-to-Ground, Ring-to-Ground, and Ring-to-Tip **on 2-wire Loop and 2-wire Ground-Start trunks**. The DC voltage from TR-to-Ground, T1R1-to-Ground and TR-to-T1R1 may be measured **on 4-wire Loop and 4-wire Ground-Start trunks**. **On E&M trunks**, you can measure the DC voltage from E-to-Ground and M-to-Ground. All voltage readings are printed as signed values to the nearest volt. This feature may be used in either **TERM** or **BRIDGE** mode. You can **measure DC current on 2- and 4-wire Loop and Ground Start trunks** when the 930A is set to the **CONTACT** mode and terminates the trunk.

To measure DC voltage or current on a 2-wire Loop Start trunk:

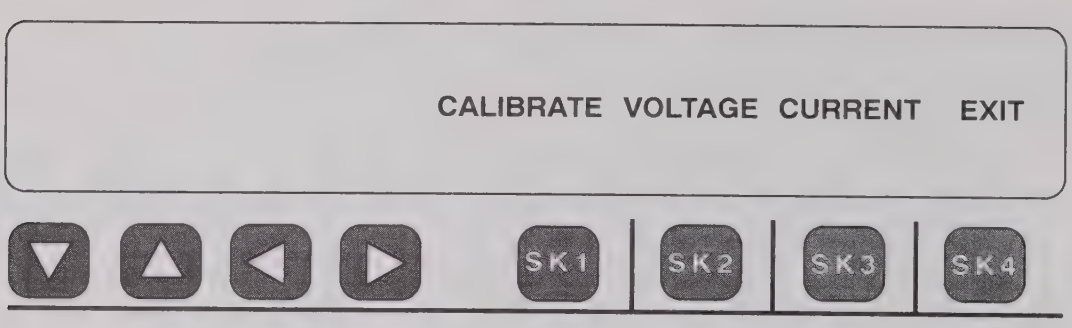
Press the OPTION MENU function key.

Use the UP/DOWN arrow keys to select Menu Option 6: DC VOLT/AMP METER.

The 930A display will be:

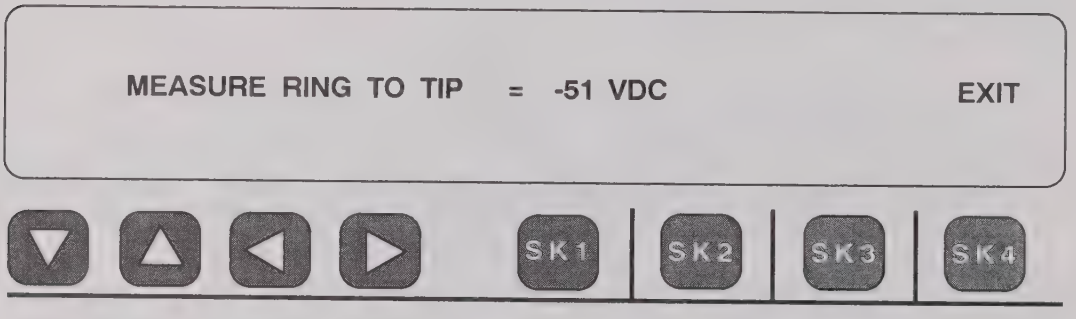


Press any softkey under the display and you will see the menu:



Press the softkey under the measurement you wish to make, or press Softkey 1 under **CALIBRATE** to make the 930A calibrate itself prior to making a measurement. Press **CALIBRATE** prior to any current measurements.

To measure DC Voltage, press Softkey 2 under **VOLTAGE** and you will see a display similar to:

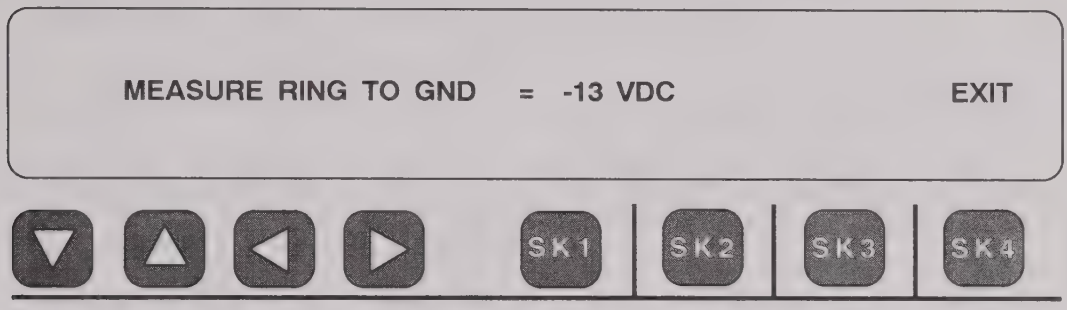


In this case, the contact side of the circuit is **ON HOOK** because the voltage is high. If the contact side goes **OFF HOOK** then a lower reading will be expected as current is drawn through the loop and voltage drops occur. A typical Ring-to-Tip voltage, after the contact side goes **OFF HOOK**, might be less than -45 volts.

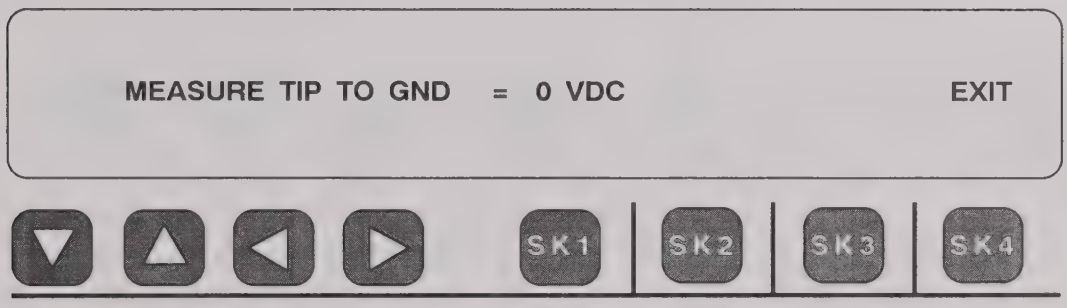
If no drop had occurred, this would indicate an open loop. Further checking along the circuit path would be required to determine the source of the open.

To measure the voltages from Ring-to-Ground and Tip-to-Ground under **ON** and **OFF HOOK** states, press Softkey 1 and the display will scroll to the next state.

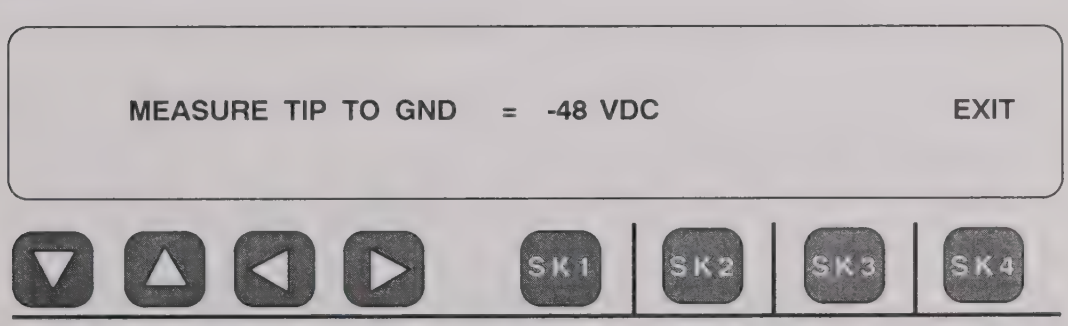
An example of a typical Ring-to-Ground measurement if the contact side goes **OFF HOOK** is shown below:



Pressing Softkey 1 advances the 930A to measuring the Tip-to-Ground voltages. An idle state (both sides **ON HOOK**) should give the following display:



This is the proper indication for a Loop Start trunk in the idle state. When the battery side goes **OFF HOOK**, a typical display of Tip-to-Ground voltage would be:

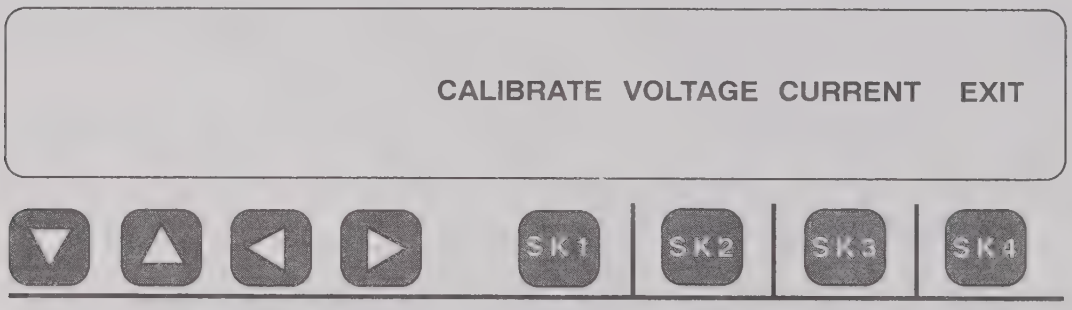


This indicates a battery reversal. Unless these or similar readings were obtained, there would be an indication of trouble in the loop supervision circuitry. Press Softkey 4 under **EXIT** to return to the main menu.

The following table lists the range and accuracy of the various 2-wire and 4-wire DC Voltage measurements the 930A can make.

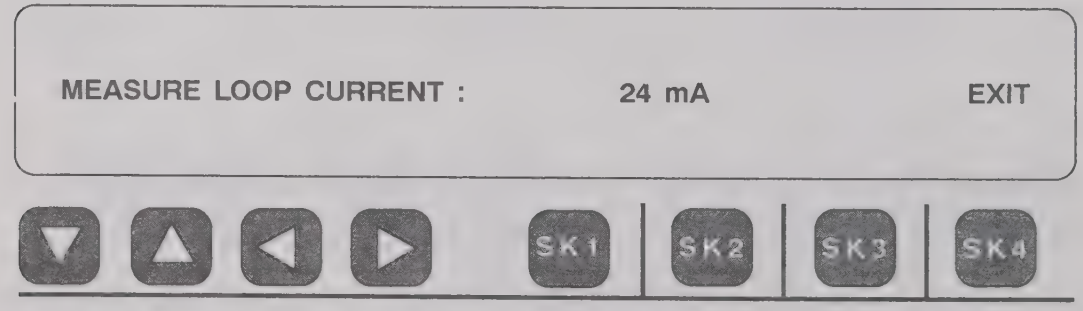
	RANGE	ACCURACY
Tip-to-Ring and **TR-to-T1R1:**	+60.0 to -60.0	+/- 1 volt
Tip-to-Ground and **Ring-to-Ground:**	+0.0 to -60.0	+/- 1 volt
TR-to-Ground and **T1R1-to-Ground:**	+0.0 to -60.0	+/- 1 volt
M-to-Ground and **E-to-Ground:**	+0.0 to -100.0	+/- 1 volt

NOTE: Refer to Section 3-10.5 **SUPERVISION THRESHOLDS** , for a description of the expected voltage levels and 930A supervision.



To measure DC current, the 930A Trunk Type must be set for 2- or 4-wire Loop or Ground Start, CONTACT and Terminate operation. Prior to measuring the current, you should remove the test cords from the 930A and press Softkey 1 under **CALIBRATE** in the main menu shown above. After calibrating the 930A you may then reconnect the test cords.

Press Softkey 3 under **CURRENT** in the main menu and the loop current measurement will be displayed. A typical display would look like:



Error messages are provided if you try to measure a parameter without having the Trunk Type correctly set up.

The previous display explains that the 930A expects the **BATTERY** (Central Office) side of a loop start circuit to provide -48 VDC on Ring (**2-wire**) or T1R1 (**4-wire**) in **NORMAL** mode. In **LOOP REVERSE**, the 930A expects to see -48 VDC on Tip (2-wire) or TR (4-wire). The 930A interprets this as the normal **ON HOOK** condition. A reversal from - to + is interpreted as the **BATTERY** side of the circuit being **OFF HOOK**. There is no voltage threshold.

Essentially, Menu Option 7 enables you to adjust the supervision voltages so the front panel LED supervision indicators will read properly under unusual circumstances.

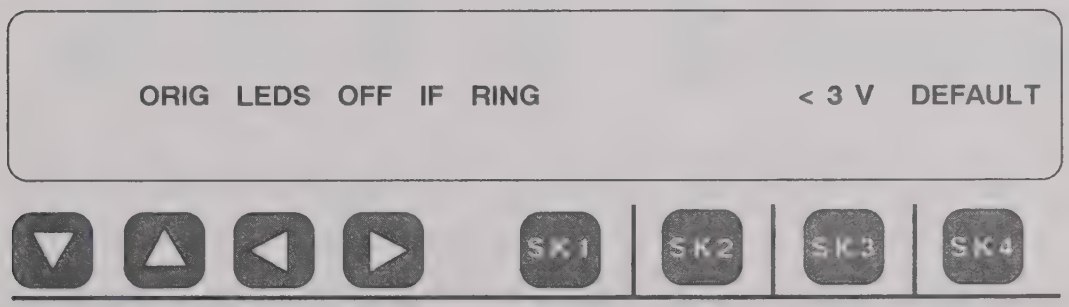
IT DOES NOT MEAN THAT THE 930A WILL OUTPUT OTHER THAN -48 VDC SUPERVISION, MERELY THAT IT WILL RECOGNIZE OTHER VOLTAGES AT ITS INPUT.

3-10.5.4 HOW TO CHANGE GROUND START THRESHOLDS

For this example, assume a 2-wire 900 ohm, NORMAL Ground Start trunk type has been selected on the 930A. Further assume that the 930A is in **CONTACT** mode simulating the originating end of the circuit.

The following describes normal 2-wire trunks. For REVERSE circuits, Tip and Ring are interchanged. On 4-wire circuits, TR replaces Tip and T1R1 replaces Ring.

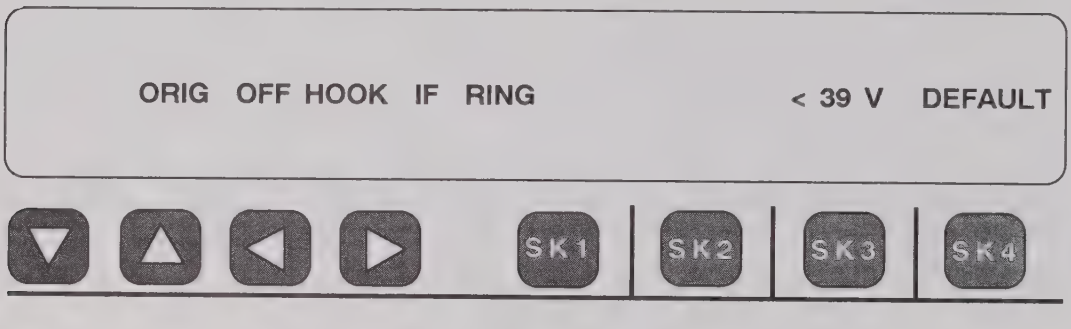
After selecting Menu Option 7 and pressing a softkey to enter the menu as previously described in Section 3-10.5.3, the 930A display will be:



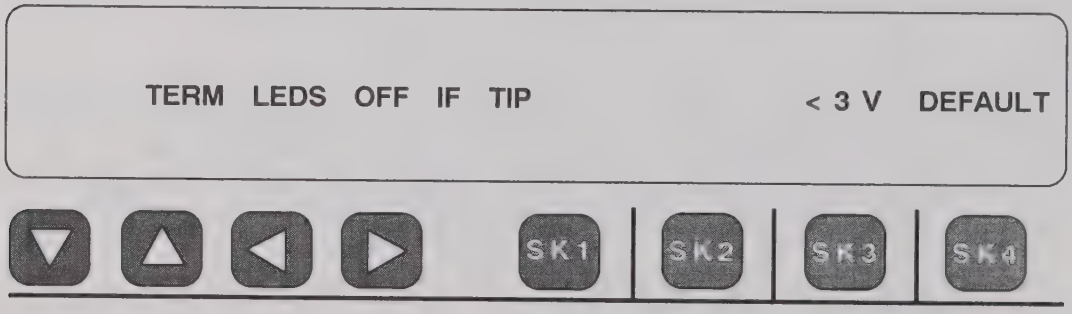
As before, this display explains that if there is no talk battery detected, there will be no voltage on Ring and the 930A will turn off the supervision LEDs on the contact side. The preset voltage threshold is 3 Volts. If you

wanted to change this value you could simply enter the desired number from the numeric keypad and press the **ENTER** key. For our purposes, however, the default value of 3 volts is acceptable without change.

Pressing Softkey 1, 2 or 3 will advance the display to:



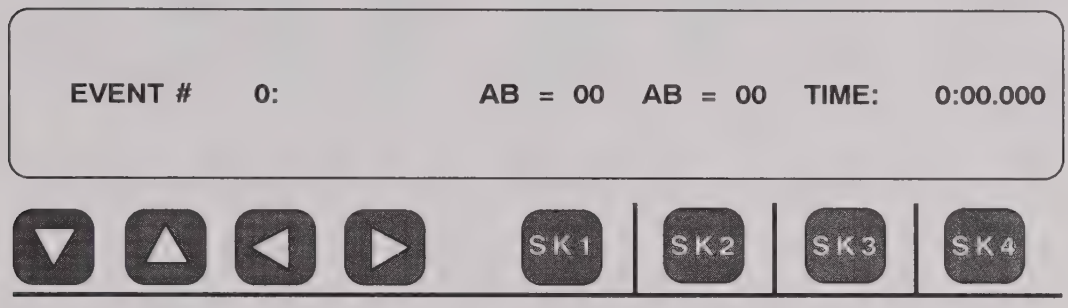
When the contact side goes **OFF HOOK**, it places ground on Ring or provides loop after the battery side has grounded Tip. In either case, the voltage on Ring goes toward ground. The preset default threshold is 39 Volts, as shown above. If the circuit is a -24 Volt system, the threshold should probably be set to about 20 Volts. Enter 2 and 0 and press **ENTER**. Press Softkey 1, 2, or 3 and the screen will advance to:



If there is no high impedance supervision battery on Tip, or a loop condition exists and there is no talk battery on Ring, there will be no voltage present on Tip and the 930A will turn off the supervision LEDs on the battery side. The factory set default is 3 Volts, as shown above. The value may be changed by entering the desired value from the numeric keypad and then pressing the **ENTER** key. For this example this value is acceptable as is.

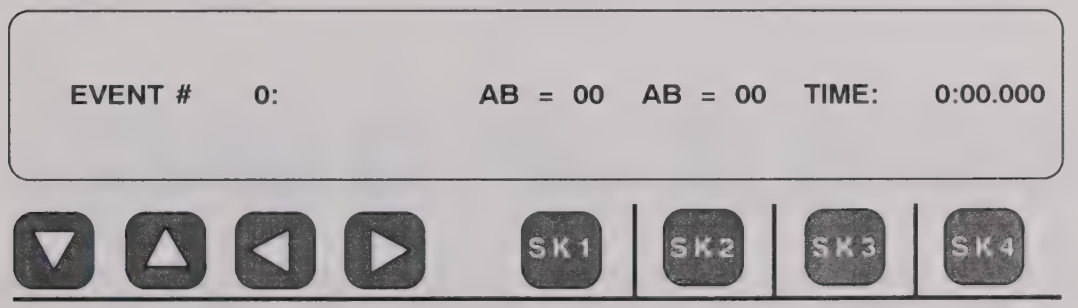
Printer and set Menu Option 3 to **PRINTER** remote. In this case the 930A will continuously dump its buffer whenever it is full, reset, and record more events.

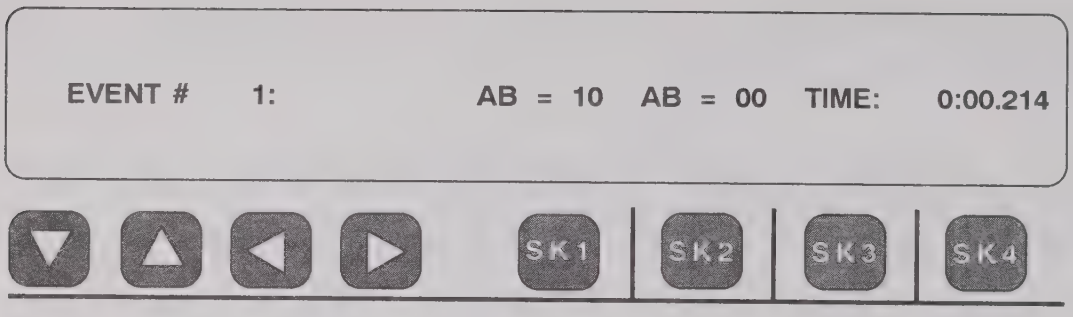
After some events have been recorded, press Softkey 4 and exit back to the main menu. Press Softkey 3 to **REVIEW** the results. When you press the **REVIEW** softkey the first display will come up as shown below.



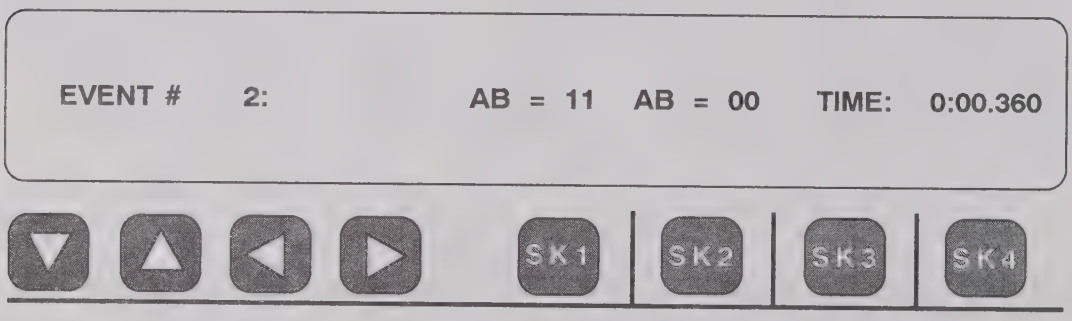
In this example, the originating, or near end A and B bits are on the left and the terminating, or far end bits are on the right. Both sides are showing **ON HOOK** since the A and B bits are 0 on both sides. The time is displayed to the right as it was for the previous analog trunk example. The A and B bit states may actually vary for **On** and **Off-Hook** indications, depending upon whether a normal trunk or a foreign exchange trunk is accessed on a real span. **If you are on an Extended Superframe span, you can press Softkey 1 or 2 to view the C and D bits as well as the A and B bits.**

Some typical measurement displays follow. You press the **UP** or **DOWN** Arrow keys, or Softkey 3 (under **TIME**), to move from event to event.



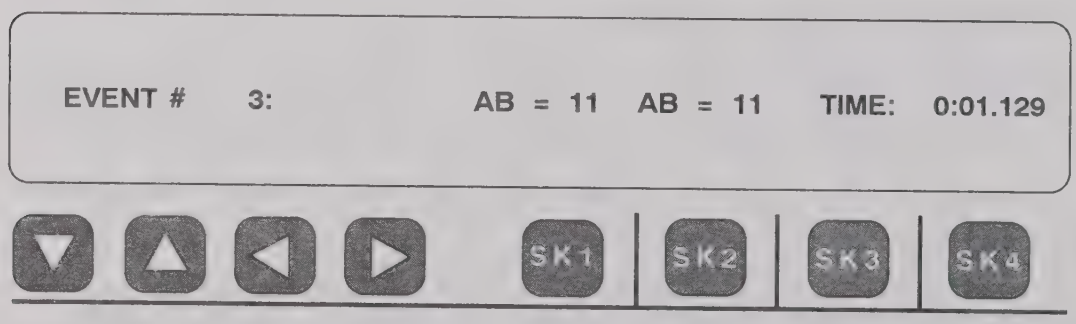


This indicates that the originating A bit went high after 214 milliseconds. Pressing the **UP** Arrow key, or Softkey 3, would bring up event #2.



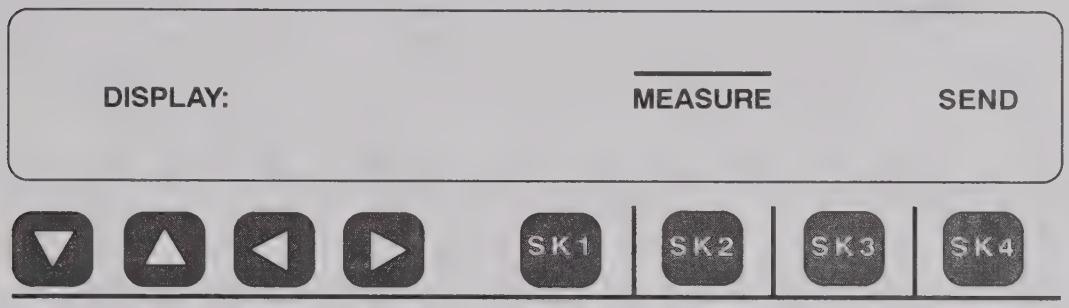
Here, the originating B bit went high 146 milliseconds after event #1 or 360 milliseconds into the measurement.

Pressing the **UP** Arrow key again brings up:

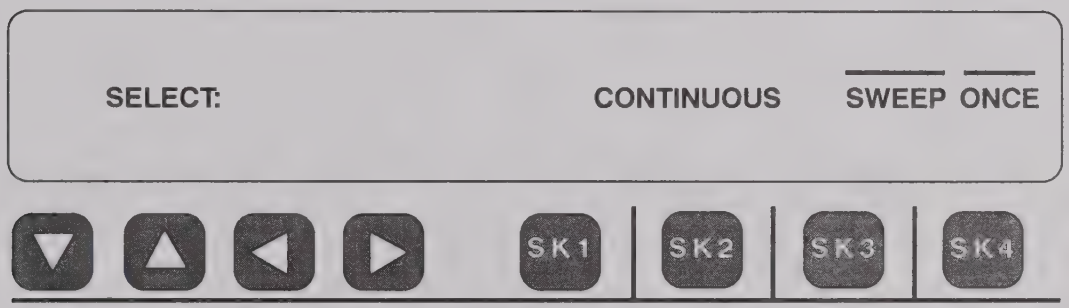


This shows that the next event was the terminating ends A and B bits going high or **OFF HOOK** after 1.129 seconds had elapsed.

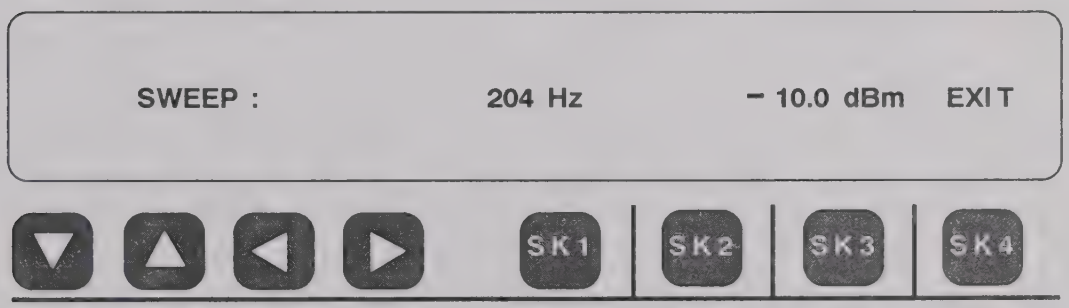
To choose the **SEND** mode of operation, press Softkey 4 (under **SEND**):



After pressing Softkey 4, the 930A display becomes:

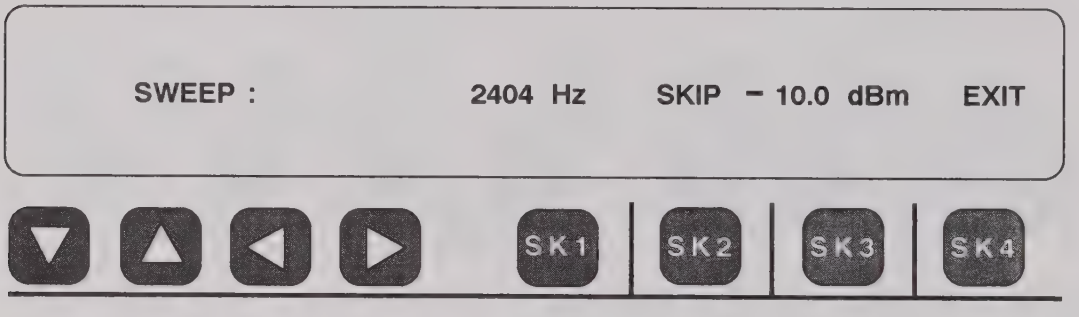


Press Softkey 2 (under **CONTINUOUS**) to continuously sweep through the band of frequencies selected, or press Softkey 4 (under **SWEEP ONCE**) to sweep once and stop. A typical 930A display might appear as:



The 930A would step the frequencies by 200 Hz, starting at 204 Hz and proceeding to 404 Hz, 604 Hz, and so on.

Since SF skip was also chosen, the 930A would hold at 2404 Hz and pick up the sweep again at 2804 Hz. The 930A display alerts you to the fact that SF is being skipped by showing the word **SKIP**:



Some final points about the Frequency Sweep Menu Option follow. You can sweep down in frequency (in this example the sweep was up in frequency) by simply making the starting frequency the higher frequency and letting the ending frequency be lower. The 930A will then figure out that you want to sweep down, instead of up. The rest of the procedure is the same as that described in the example above. If a single sweep is chosen, the 930A will revert to the main sweep menu when the sweep has been completed.* You can stop the sweep at any time by pressing Softkey 4 (under **EXIT**), or the **OPTION MENU** key itself.

* If a continuous sweep is selected, the sweep will repeat until the operator manually stops it by pressing the **OPTION MENU** function key.

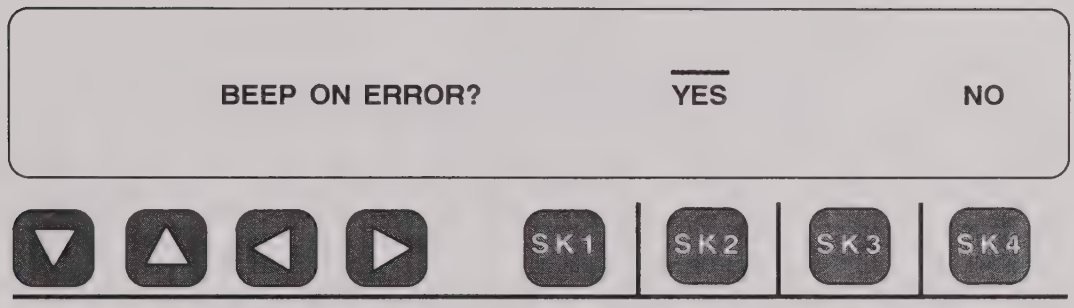
3-10.9 HOW TO STOP THE 930A FROM BEEPING (MENU OPTION 15)

Menu Option 15: **BEEP ON ERROR** provides you with an audible indication of various types of errors. These include errors of commission such as, trying to select a Trunk Type option that has not been installed. Since there are times when you don't care to listen to the beep, this Menu Option provides the means to turn off the beep without cutting the wires to the speaker. To control the **BEEP**, do the following:

Press the OPTION MENU **Option Menu** function key.

Use the UP/DOWN arrow keys to

to select Menu Option 15: BEEP ON ERROR.



If the cursor appears over the **YES** field, the **BEEP** has been turned **on**. To turn it **off**, press Softkey 4. You are now free to make all the operating mistakes you want without the annoying **BEEP** to disturb you. To turn the **BEEP** back on, return to Menu Option 15 and, once inside the menu, press Softkey 2. If you have ordered Option 930A-10C (Remote Control), disabling the beep also prevents the 930A from sending the "Bell" character (ASCII 07) to a remote printer, terminal, or computer.

Most of the time **BEEP** is encountered when using the 930A with the PCM interface (Option 930A-08E or -09E). Usually it is because you don't have the 930A hooked into a span, so it has no PCM input and wants to tell you. You can shut up the **BEEP** in this case by looping **PCM IN 1** to **PCM OUT 1**, and setting the 930A to **TERMINATE** and **INTERNAL** clock, which gives it a signal. The beep interval is now 4 seconds long. Pressing any front panel key will add another 4 seconds which enables you to set up the 930A in peace.

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3-10.14 DSP MEMORY TEST (MENU OPTION 90)

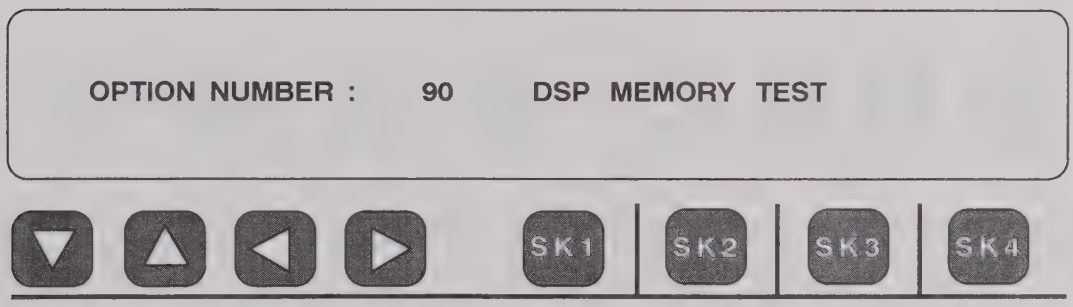
This menu is more useful to SAGE than to the customer. It is used during our manufacturing process. It checks the health of the memory on the DSP board in the 930A if you have purchased Option 930A-01. If you get strange test results in the digit receiver/analyzer even after a **"Cold Boot,"** this would be another place to check.

You get to this menu like you do the others.

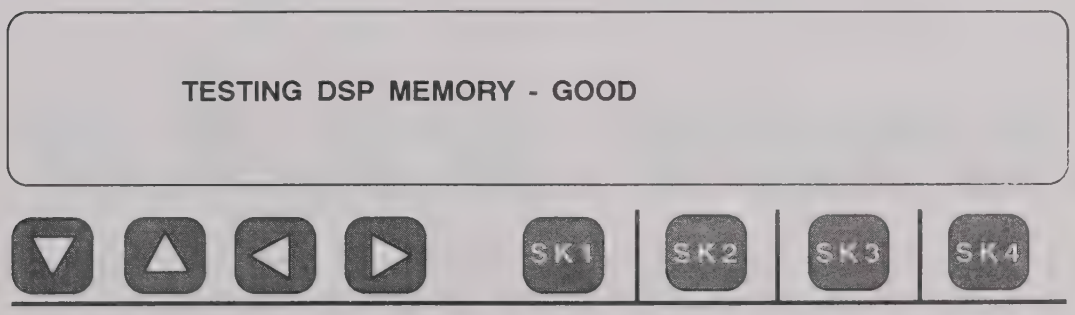
Press the OPTION MENU function key.

Use the UP/DOWN arrow keys to

select Menu Option 90: DSP MEMORY TEST



When you enter this menu you will see the following display, if all is well:



If you do not get this display, then you should call SAGE customer service at (408)761-1000. Again, **this menu only applies if you have Option 930A-01**.

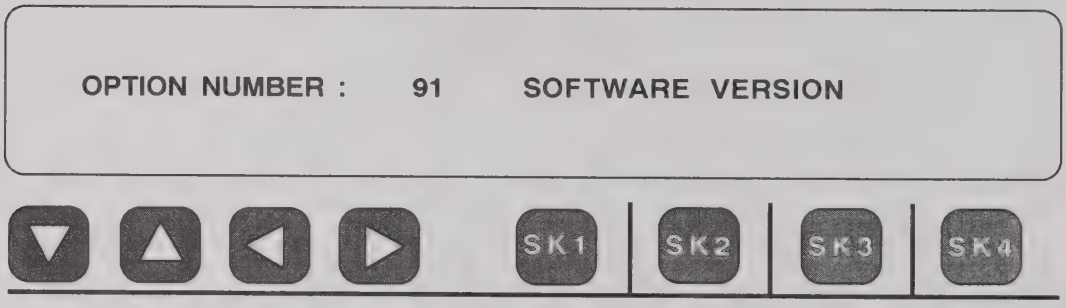
3-10.15 WHERE TO FIND SOFTWARE VERSION (MENU OPTION 91)

You can turn the 930A off and then on again to determine the software level you have in the unit. But this is usually inconvenient so you can now go to Menu Option 91: **SOFTWARE VERSION** by doing the following:

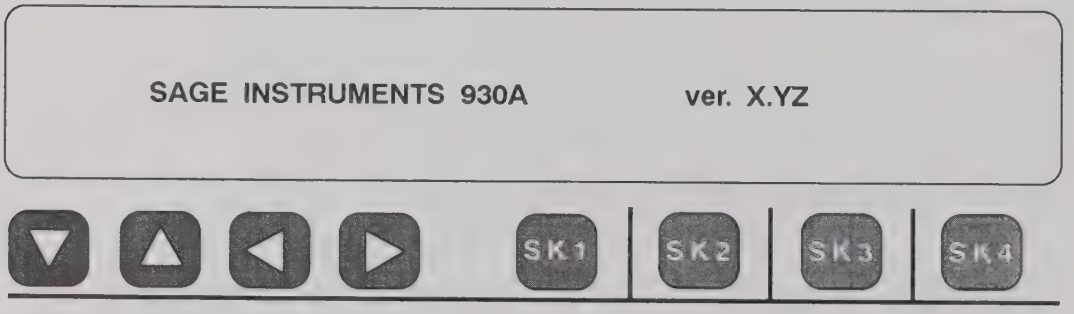
Press the OPTION MENU function key.

Use the UP/DOWN arrow keys to

select Menu Option 91: SOFTWARE VERSION.



When you press any softkey under the display, you will see the version of software you have in your 930A.



The operating system software in the 930A is updated from time to time. Upgrades to the current software version are free to the original owners for life. You may call SAGE Customer Service from time to time to see if you need to upgrade from your existing system. Usually this is not necessary unless we have added something to the list of standard features that your software does not have.

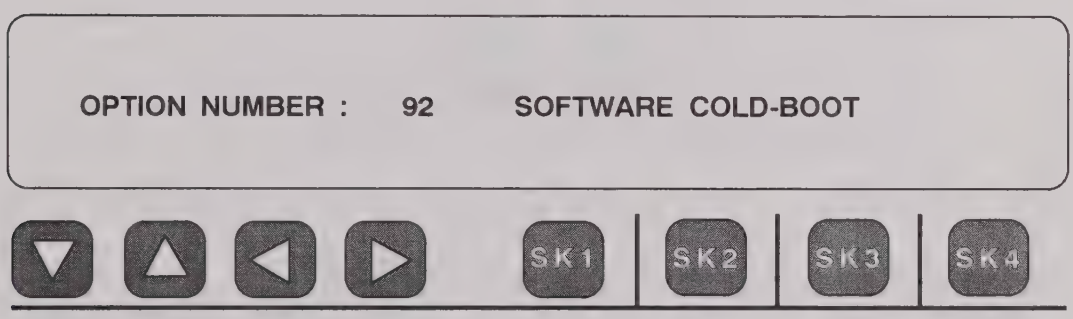
3-10.16 HOW TO DO A SOFTWARE COLD-BOOT (MENU OPTION 92)

Rather than doing a full Hardware Cold-Boot such as you would do when you change software in the 930A, you can do a Software Cold-Boot which is useful in restoring the 930A to its factory default settings. Someone else may use your 930A from time to time and may set in parameters that will affect your readings. This is a convenient way of starting from scratch so to speak. **The Software Cold-Boot does not affect the Remote Control settings (Menu Option 3).**

Press the OPTION MENU function key.

Use the UP/DOWN arrow keys to

select Menu Option 92: SOFTWARE COLD-BOOT.



WARNING! Once you press any softkey and enter this menu you will Cold-Boot the 930A. All memories will be erased and the factory defaults will be restored. The 930A will return to the 2-wire LOOP START Trunk Type default.

If you do not want to do this, then go to some other Menu Option and do not enter the one above. **Never enter this menu when the 930A is connected to a circuit.**

3-10.17 THE TEST DISPLAY (MENU OPTION 93)

This Menu Option is mainly used during manufacturing to test the display and the LEDs by turning everything on.

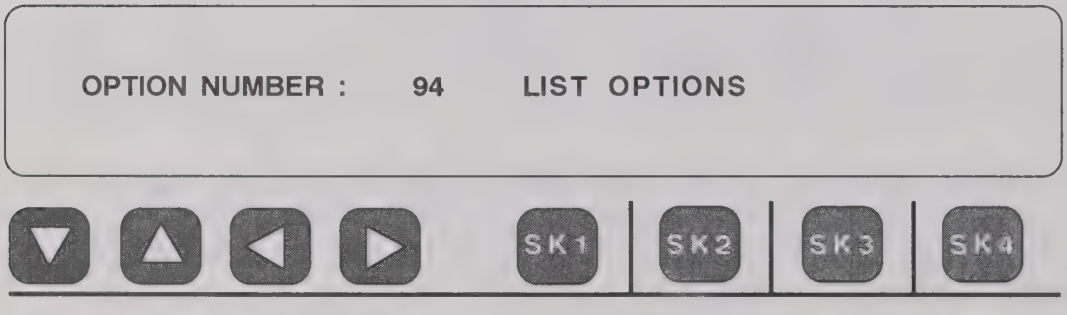
To get out of this menu, if you have entered it, just press the **OPTION MENU** key and you will get outside again.

3-10.18 HOW TO FIND OUT WHAT OPTIONS ARE INSTALLED IN YOUR 930A (MENU OPTION 94)

Menu Option 94: **LIST OPTIONS** tells you what purchased options you have in your 930A. You get to it by the following steps.

Press the OPTION MENU function key.

Use the UP/DOWN arrow keys to select Menu Option 94: LIST OPTIONS.



Once you get to this menu, press any of the softkeys below the display and the 930A will show you a screen such as the one on the following page.

Remember: The purchased option numbers do not match the Menu Option numbers. Refer to Table 4-1, on pages 4-3 and 4-4 in the next section, to match the purchased option numbers with their locations under the Option Menu Function key.

3-10.20 SENDING DIAL-TONE, BUSY AND OTHER DUAL TONE SIGNALS (MENU OPTION 35)

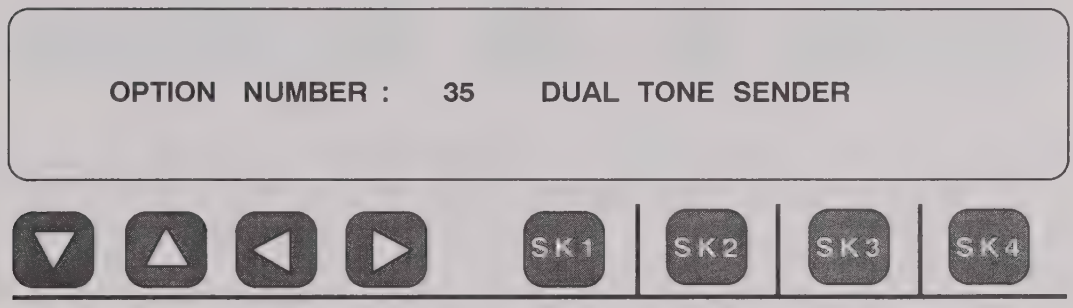
The 930A is capable of sending any dual tone signal whose two tones fall within the 930A frequency range. For the convenience of the user, the 930A has several preset signals. These are Dial-Tone, Busy and Reorder. But you can input any two tones you wish and set their levels and their on and off times as well. The following steps outline the procedure for using this menu option.

Press the OPTION MENU

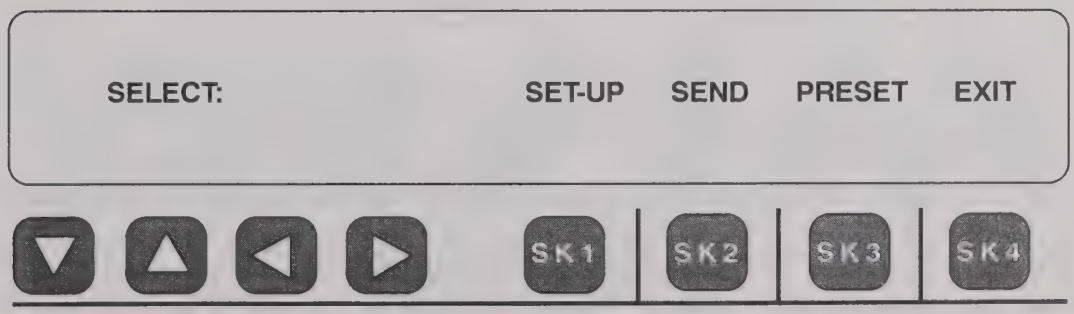
function key.

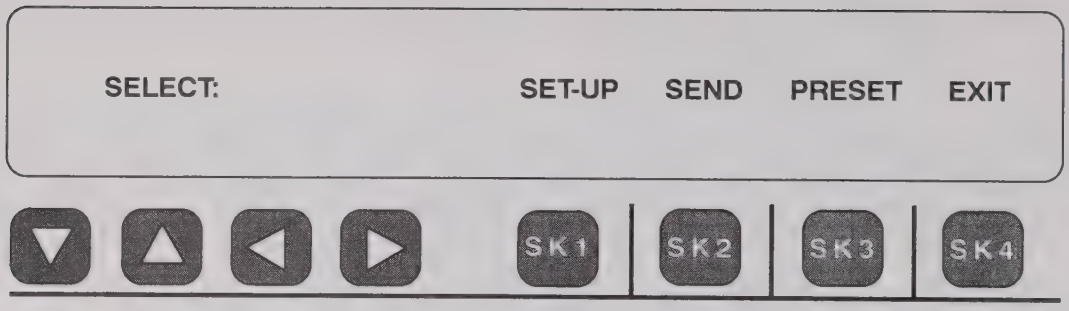
Use the UP/DOWN arrow keys to

select Menu Option 35: DUAL TONE SENDER.

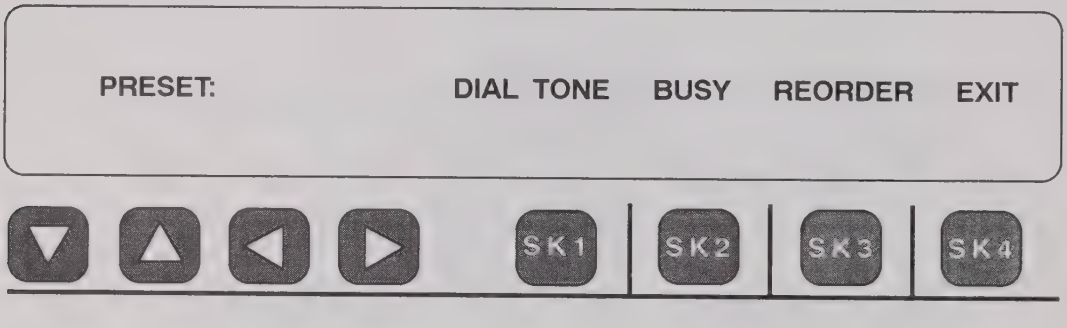


Press any softkey and the main SELECT display will appear.

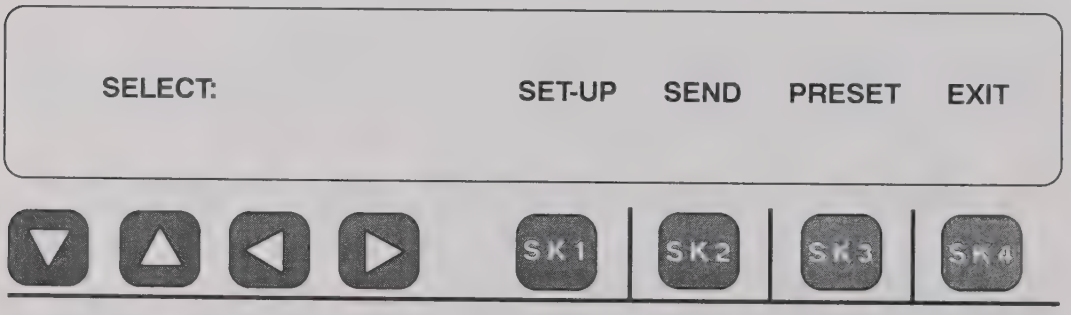




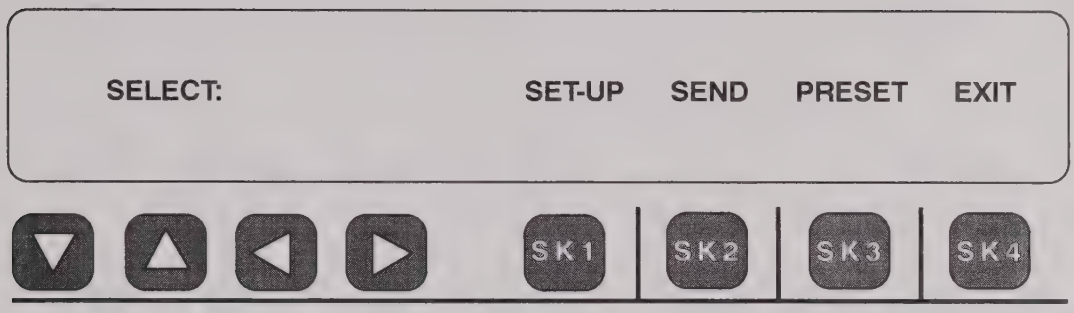
To select and send a standard preset signal such as Dial Tone, Busy or Reorder press Softkey 3 under PRESET. The display becomes:



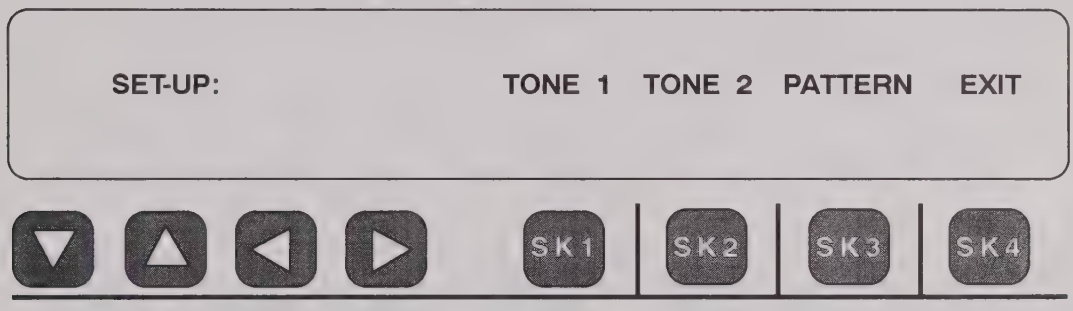
Make your selection by pressing the softkey directly below the tones you want to send. For instance, pressing Softkey 2 under BUSY will select the trunk busy signal. Once you have made your selection you will be returned to the main SELECT menu.



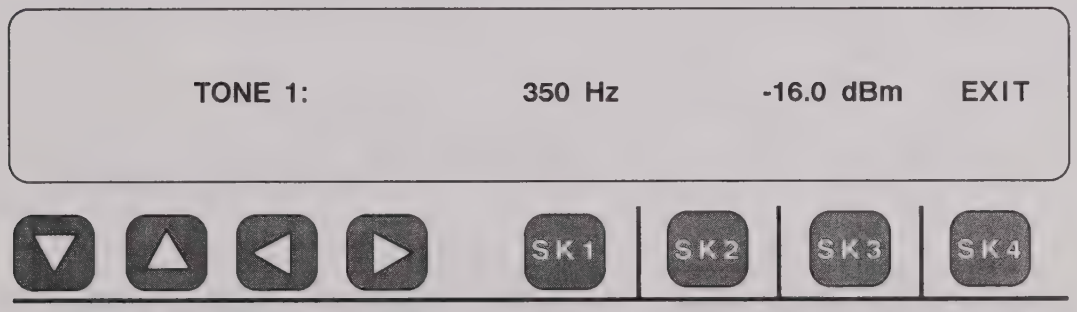
At this point, press Softkey 2 under SEND to begin sending the tones you selected. A flashing cursor will appear over SEND while you are transmitting. To stop sending, press Softkey 2 again or press Softkey 4 under EXIT.



To send a two tone signal other than the PRESET tones, use the SET-UP menu. Press Softkey 1 to enter the SET-UP display.



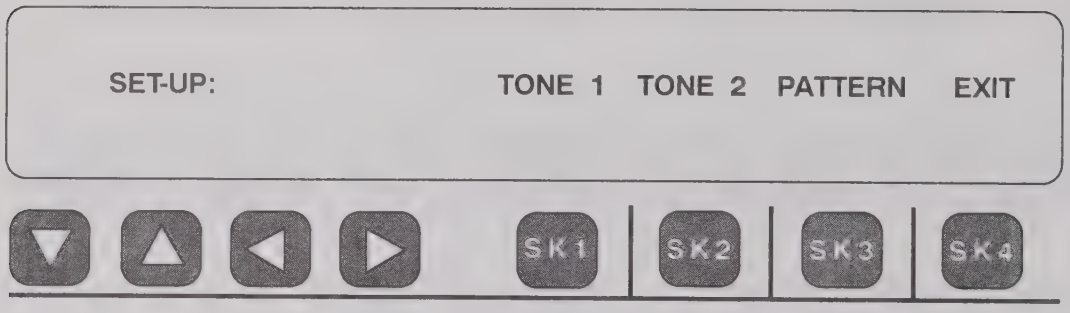
Begin by setting the level and frequency of TONE 1. To do this, press Softkey 1 under TONE 1. A display similar to the following will appear:



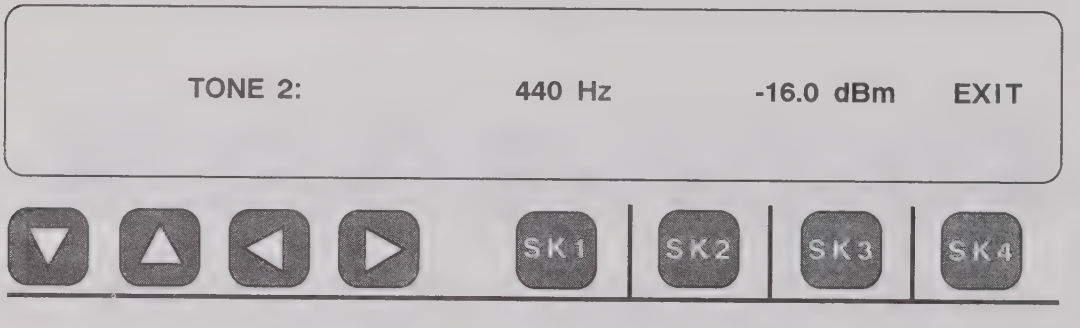
To change the frequency of the tone press Softkey 1 (under 350 Hz in this example) and then enter the desired frequency from the keypad. Press the ENTER key to complete the selection.

To change the level of the tone press Softkey 3 (under -16.0 dBm in this example) and then enter the desired level from the keypad. Press the ENTER key to complete the selection. Press Softkey 4 under EXIT to return to the

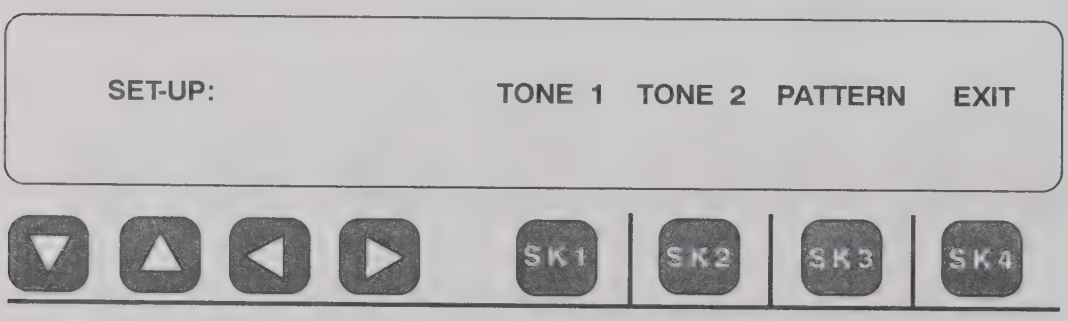
main set-up menu.



To change the level and frequency of TONE 2 press Softkey 2 and a display like the one below will appear.

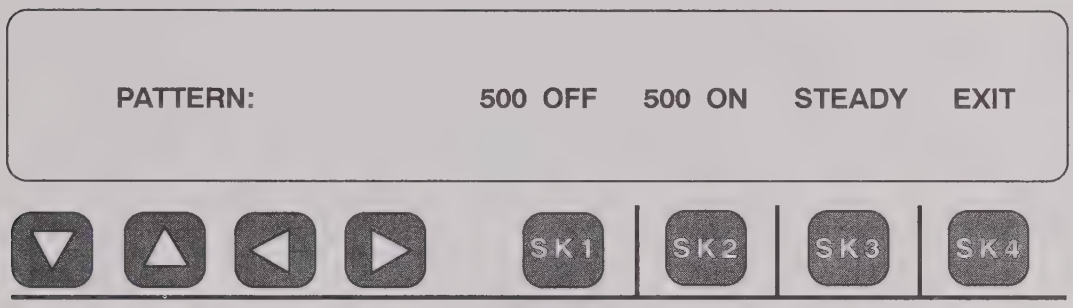


Repeat the procedure previously outlined for TONE 1 to modify TONE 2. When you have set TONE 2, press Softkey 4 to exit back to the SET-UP menu.



You are now ready to change the timing or pattern of the dual tone signal.

To change the Pattern, press Softkey 3 under PATTERN and the display will change to:



You can set the time your tones will be on and off or you can have them transmit steadily. For example, Dial Tone is sent continuously or STEADY. Busy is sent at 0.5 seconds ON and 0.5 seconds OFF as shown above. The display shows time in milliseconds so 0.5 seconds is shown as 500 milliseconds.

To change the ON and OFF times, press Softkey 1 under OFF and enter the desired time using the keypad and then press Softkey 2 under ON to change the on time.

To send a signal continuously, press Softkey 3 under STEADY and then press Softkey 2 under SEND in the SELECT menu. Notice that in this case the ON and OFF times are blank.

When you have made your selections, press Softkey 4 to exit.

To send your creation, press Softkey 2 under SEND in the SELECT menu just as you did for PRESET tones.

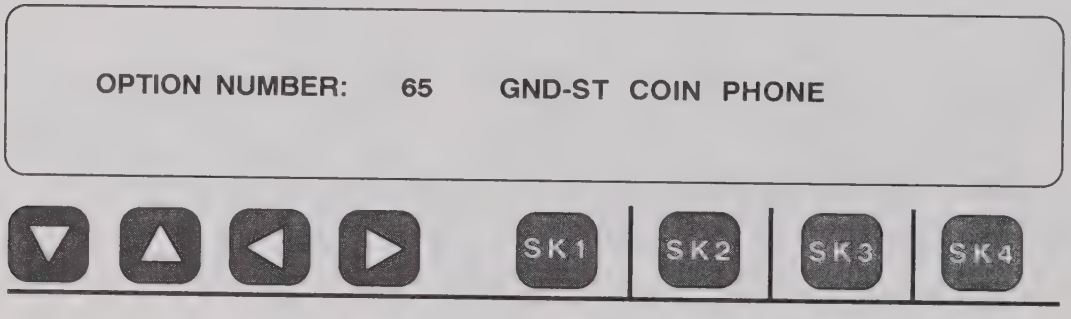
3-10.21 SETTING THE 930A TO WORK ON GROUND START COIN PHONE TRUNKS (MENU OPTION 65)

If you have occasion to use the 930A on Coin Phone trunks you will sooner or later encounter Ground Start trunks. While the 930A does provide ordinary Ground Start supervision under the TRUNK TYPE menu this is not enough when dealing with coin phone circuits. Menu Option 65: GND-ST COIN PHONE was added to the 930A to take care of this special case of Ground Start. You must first set the 930A TRUNK TYPE to the appropriate Ground Start trunk settings. Then do the following:

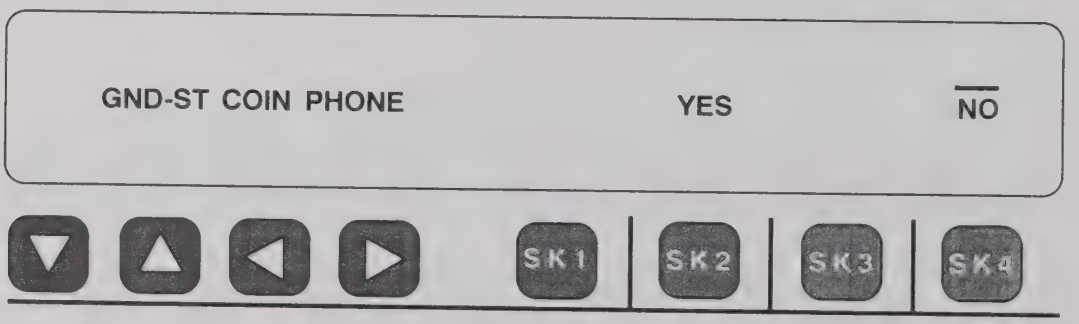
Press the OPTION MENU function key.

Use the UP/DOWN arrow keys to

select Menu Option 65: GND-ST COIN PHONE.



Press any softkey under the display to get to the main menu:



Press Softkey 2 under YES to place the 930A in the coin phone mode. The 930A functions and menu options continue to operate as usual.

SECTION IV
OPTIONS

4-1 INTRODUCTION

The Model 930A may be equipped with a number of **optional features** which expand and enhance its test and measurement capabilities. This section describes the **operation** of the Model 930A when equipped with these available **options**.

This list shows the currently available options for the Model 930A. A N/A indicates that there is no write up needed for the option.

OPTION	DESCRIPTION	SECTION
930A-01	MF/DTMF/DP Receiver and Analyzer	4-2
930A-02	SF Supervision	4-3
930A-06	P/AR Measurement	4-4
930A-07	3-Level Impulse Noise	4-5
930A-08E	Single Direction DS-1 PCM Access	Sect. VI
930A-09E	Dual Direction DS-1 Drop and Insert	Sect. VI
930A-10C	RS-232C Remote Control/Printer Interface with Real Time Clock (Covered in Section V).	Sect. V
930A-12	ROTL/Near End Responder/Far End Responder (Type 105 Compatible) (Requires Option 930A-01).	4-6
930A-13	Ring Generator/REN-3 Load	4-7
930A-14	LTTP/STTP (1/1A ESS) Interface	N/A
930A-16	-48 VDC Power Supply	N/A
930A-17	Removes 2W/4W Metallic Interface (Requires Option 930A-08E or -09E)	N/A
930A-18	Phase Jitter/Hits (Requires Option 930A-07)	4-8
930A-19	Envelope Delay Distortion	4-9
930A-20*	4-Tone Intermodulation Distortion	4-10
930A-22	DS-1/DS-0 Bit Error Rate Testing (Requires Option 930A-08E or -09E)	6-17

* Licensed under Hekimian Laboratories Patent No. 3,862,380

OPTION	DESCRIPTION	SECTION
930A-25	FXO/FXS Supervision (Requires Option 930A-08E or -09E)	6-12
930A-27	Digital Switch Corporation Software	N/A
930A-29	Batch Mode Testing	4-11
930A-32	64K RAM Buffer (Used with Option 930A-29)	N/A
930A-35	Near End Responder/Interrogator for HLI Type 125 Far End Responders (Requires Option 930A-01)	4-12
930A-36	Extends Warranty to 3 years	N/A

This part of the manual is organized by option number and proceeds in order from Option 930A-01. The exceptions to this rule are: Option 930A-10C which is described in Section V, **REMOTE CONTROL OPERATION**, Options 930A-08E, -09E and -22 which are described in Section VI, **T-CARRIER MEASUREMENTS** and Options 930A-14, -16, -17, -27 and -36 which are self-explanatory.

To prevent possible confusion between purchased option numbers and the Option Menu numbers, Table 4-1 provides a cross reference.

TABLE 4-1
MENU OPTION NUMBERS

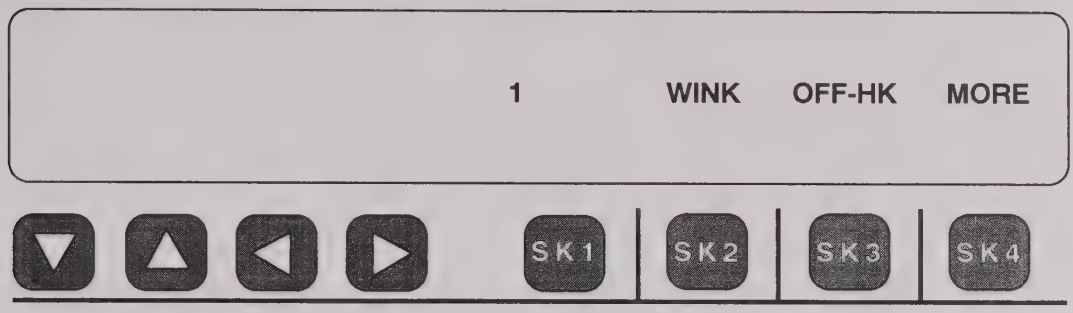
MENU OPTION NUMBER	DESCRIPTION	PURCHASED OPTION
OPTION NUMBER: 1	MODIFY DIAL/RING	STANDARD
OPTION NUMBER: 2	SEND DIGIT SEQUENCES	STANDARD
OPTION NUMBER: 3	REMOTE CONTROL	OPTION 930A-10C
OPTION NUMBER: 4	DIGIT RECEIVER	OPTION 930A-01
OPTION NUMBER: 5	REN-3 LOAD	OPTION 930A-13
OPTION NUMBER: 6	D.C. VOLT/AMP METER	STANDARD
OPTION NUMBER: 7	SUPERVISION THRESHOLDS	STANDARD
OPTION NUMBER: 8	SUPERVISION MONITOR	STANDARD
OPTION NUMBER: 9	WINK TIMING	STANDARD
OPTION NUMBER: 10	FREQUENCY SWEEP	STANDARD
OPTION NUMBER: 11	IMPULSE NOISE & HITS	OPTION 930A-07
OPTION NUMBER: 12	WINK MARGINING	OPTION 930A-01
OPTION NUMBER: 13	PHASE/AMPLITUDE JITTER	OPTION 930A-18
OPTION NUMBER: 14	SET TIME AND DATE	OPTION 930A-10C
OPTION NUMBER: 15	BEEP ON ERROR	STANDARD
OPTION NUMBER: 16	RESERVED	
OPTION NUMBER: 17	ENVELOPE DELAY DISTORTION	OPTION 930A-19
OPTION NUMBER: 18	PEAK/AVERAGE RATIO	OPTION 930A-06
OPTION NUMBER: 19	4-TONE INTERMODULATION	OPTION 930A-20
OPTION NUMBER: 20	24 BIT DISPLAY	OPTION 930A-08E OPTION 930A-09E
OPTION NUMBER: 21	TOGGLE A/B BITS	OPTION 930A-08E OPTION 930A-09E
OPTION NUMBER: 22	RESERVED	
OPTION NUMBER: 23	RESERVED	
OPTION NUMBER: 24	RESERVED	
OPTION NUMBER: 25	FAR END RESPONDER	OPTION 930A-12
OPTION NUMBER: 26	ROTL/NEAR END RESPONDER	OPTION 930A-12
OPTION NUMBER: 27	ROTL INTERROGATOR	OPTION 930A-12
OPTION NUMBER: 28	TRANSPONDER TEST	OPTION 930A-35
OPTION NUMBER: 29	CALL 102 LINE	OPTION 930A-29
OPTION NUMBER: 30	ADJUST TLP	STANDARD
OPTION NUMBER: 31	SEND HOOK FLASH	STANDARD
OPTION NUMBER: 32	DIAL-UP TESTLINE	STANDARD
OPTION NUMBER: 33	DIAL-UP SWEEP	STANDARD
OPTION NUMBER: 34	SELECT REPORTS	OPTION 930A-10C

TABLE 4-1 (Continued)
MENU OPTION NUMBERS

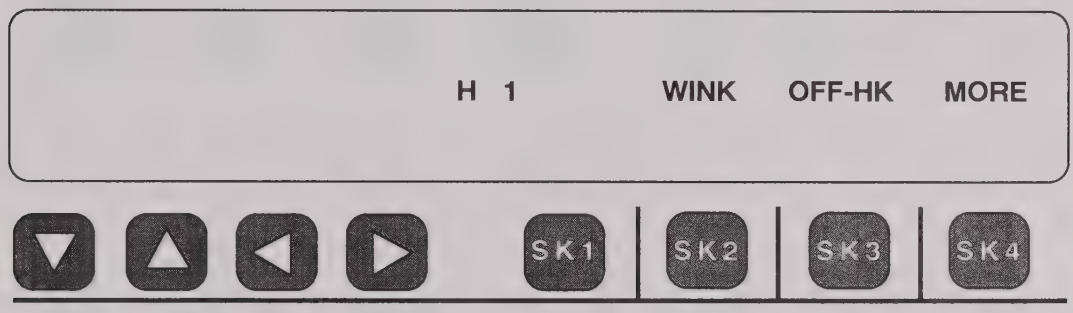
MENU OPTION NUMBER	DESCRIPTION	PURCHASED OPTION
OPTION NUMBER: 35	DUAL TONE SENDER	STANDARD
OPTION NUMBER: 37	LINE STATUS	OPTION 930A-10C
OPTION NUMBER: 40	SEND PCM ALARMS	OPTION 930A-08E OPTION 930A-09E
OPTION NUMBER: 41	READ T1 VOLTAGE	OPTION 930A-08E OPTION 930A-09E
OPTION NUMBER: 42	T1 WANDER	OPTION 930A-08E OPTION 930A-09E
OPTION NUMBER: 43	ERROR COUNTERS	OPTION 930A-08E OPTION 930A-09E
OPTION NUMBER: 44	T1 ERROR HISTORY	OPTION 930A-09E
OPTION NUMBER: 45	T1 ERROR INJECT	OPTION 930A-09E
OPTION NUMBER: 46	DS-1 BIT ERROR RATE	OPTION 930A-22
OPTION NUMBER: 47	APS TEST	OPTION 930A-22
OPTION NUMBER: 50	BATCH MODE	OPTION 930A-29
OPTION NUMBER: 51	TEST RESULTS	OPTION 930A-29
OPTION NUMBER: 52	E911 EMULATION	OPTION 930A-37
OPTION NUMBER: 56	DS-0 BIT ERROR RATE	OPTION 930A-22
OPTION NUMBER: 57	DS-O LOOPBACK	OPTION 930A-22
OPTION NUMBER: 65	GND-ST COIN PHONE	STANDARD
OPTION NUMBER: 89	PRINTER HAND SHAKE	OPTION 930A-10C
OPTION NUMBER: 90	DSP MEMORY TEST	STANDARD
OPTION NUMBER: 91	SOFTWARE VERSION	STANDARD
OPTION NUMBER: 92	SOFTWARE COLD-BOOT	STANDARD
OPTION NUMBER: 93	TEST DISPLAY	STANDARD
OPTION NUMBER: 94	LIST OPTIONS	STANDARD
OPTION NUMBER: 95	DRY CIRCUIT	STANDARD
OPTION NUMBER: 96	TEST EXTENDED RAM	OPTION 930A-32
OPTION NUMBER: 97	HOLD CONTROL	STANDARD

Menu Option Numbers which are not used are reserved for future expansion.

IMMEDIATE DIAL (See Example in Section 4-2.2)



IMMEDIATE DIAL ON GROUND START (See Example in Section 4-2.3)

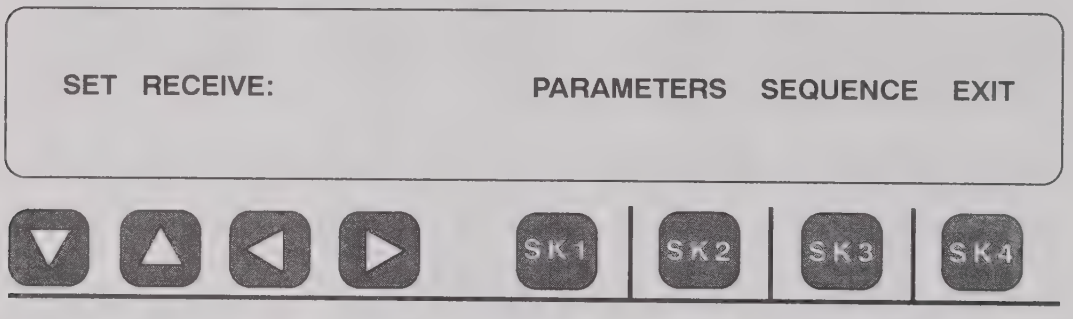


How did we generate these displays? **Easy**. All that was done for the **Wink Start** Trunk was to press Softkey 2 (under **WINK**) and the **W** appeared. This tells the 930A to give the far end a **Wink** when it sees the Trunk being seized. Then the number **1** was entered to tell the 930A to receive a single "Record" (since this was a regular domestic call example) from the far-end. Last but not least, an **OFF-HOOK** was entered so that answer supervision could be returned and timed. This was done by pressing Softkey 3 under **OFF-HK** and an **H** appeared after the **W 1**.

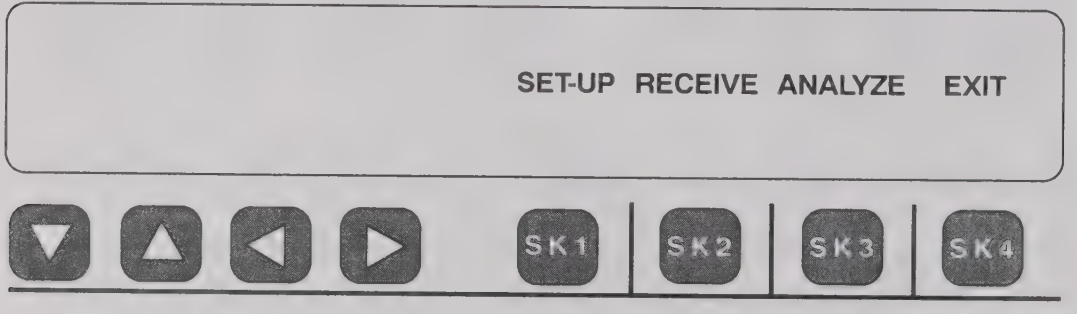
For the **IMMEDIATE DIAL** Trunk, it is even easier. You tell the 930A that a Record is coming right after the Trunk is seized. There are no winks involved. You enter a **1** from the keypad and press **ENTER**. This is shown in the display above. You could leave it at this just to capture digits, but it is a good idea to send back an **OFF-HOOK** when you terminate a Trunk. So enter an **H**, after the **1**, by pressing Softkey 3 (under **OFF-HK**) and the display will read **1 H** instead of just **1**.

On a Ground Start Trunk, you must start with an **Off-Hook**, so here you enter the **H** first and then the **1**. The sequence would be **H 1** in this case. **Do not be afraid to make a mistake** because you can always press the **CLR** key and start again.

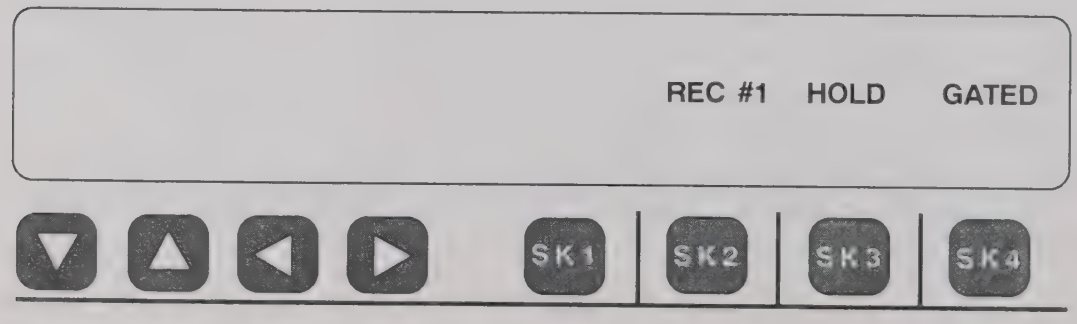
After you have entered the sequence into the 930A, press the **OPTION MENU** key and you will see the main **SET-UP** display return:



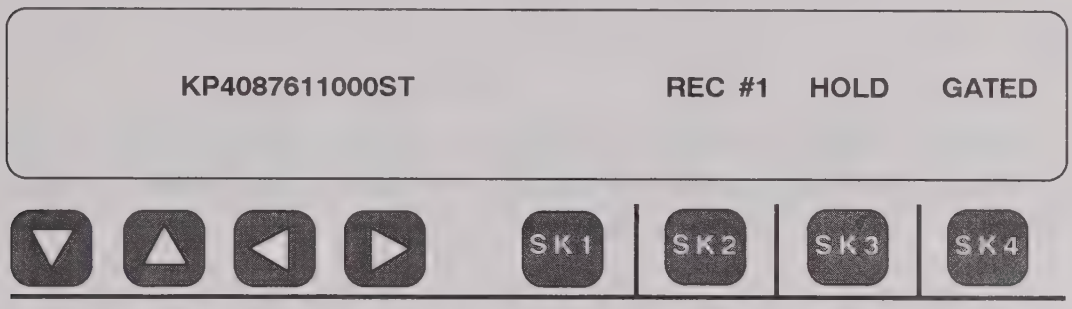
Now, press Softkey 4 (under **EXIT**) and the 930A display will back out another step to the main selection menu:



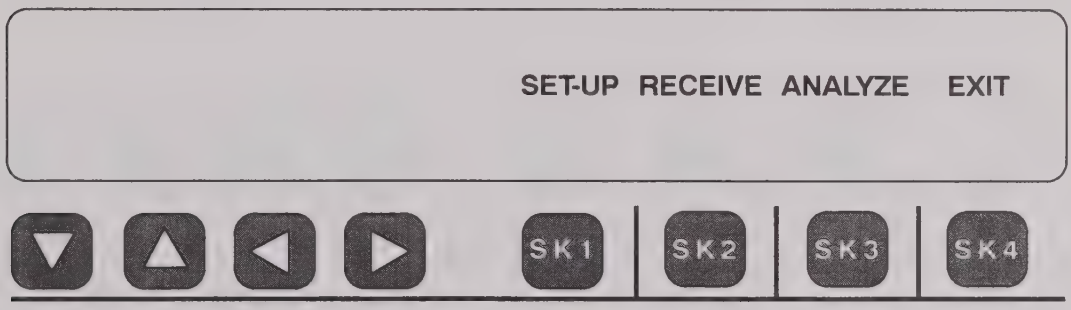
To receive digits, press Softkey 2 (under **RECEIVE**) to activate the digit receiver.



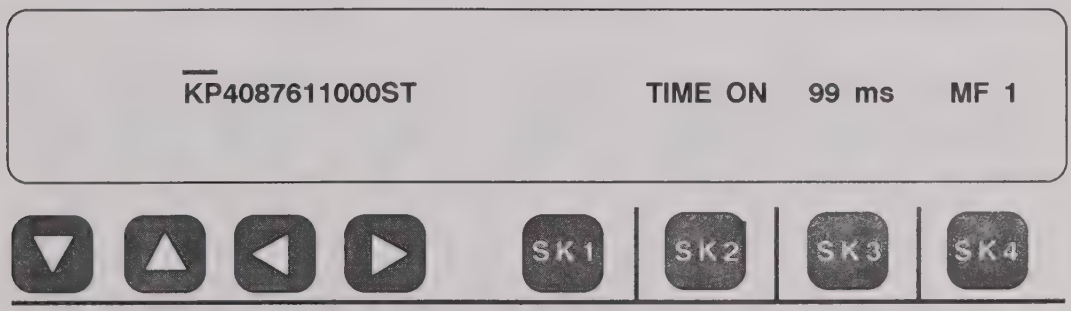
The next time the trunk is seized, and digits are sent, you should see them come across the 930A display. An example might look like:



Once the digits have been received, you can press the **OPTION MENU** key to back out of the Receiver to the main display.



At this point, press Softkey 3 (under **ANALYZE**) to review the characteristics of each digit in the string you received. A sample display appears below:



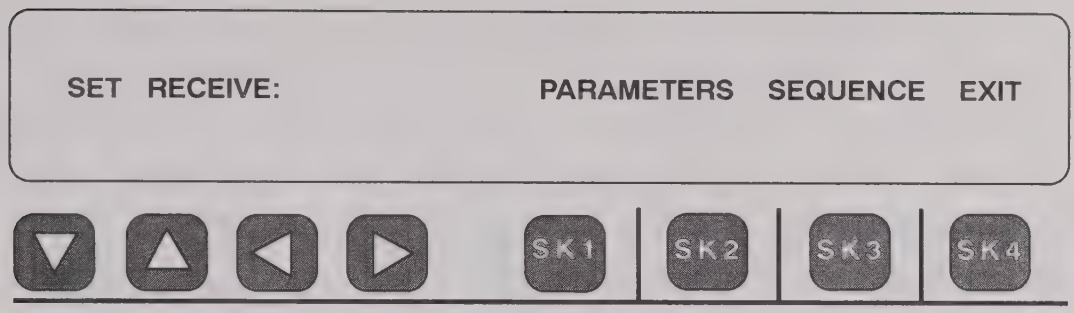
In the above example, an **MF** "Record" has been received. The cursor starts out over the first digit. In this case it is the **KP**. By pressing Softkey 2, you can page through the levels and frequencies of the two tones which make up the **KP** as well as their **On** and **Off** times. You can then use the right arrow key to move the cursor to the next digit, and so on.

If you had set the 930A to receive a Multi-Wink call such as a Feature Group D sequence, then the 2 or more "Records" would be stored in the Analyzer. You would be able to look at them by pressing Softkey 4 (under **MF 1**) in the example display on the previous page. This acts like a "wheel" and pages you through Records 1 to 4 and then back to 1 again.

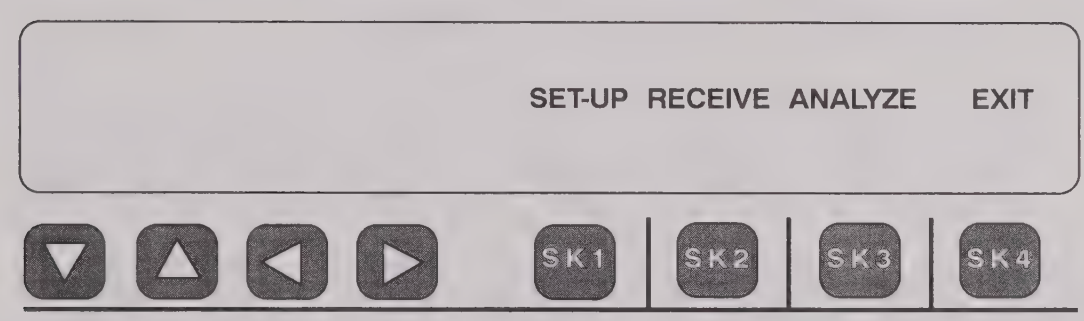
When you are through, press the **OPTION MENU** key to back out of the Analyzer display. From the main menu, you can exit entirely from this Option, or go back into the Receiver to collect more digits.

If you have a Printer connected to the 930A, then the 930A will automatically go on receiving digits, and print the Digit Analysis with a Time/Date stamp on the printout. Wink Timing results from Menu Option 9 will also be printed if you are testing on a 4-wire analog trunk or a T-1 span (Option 930A-09E).

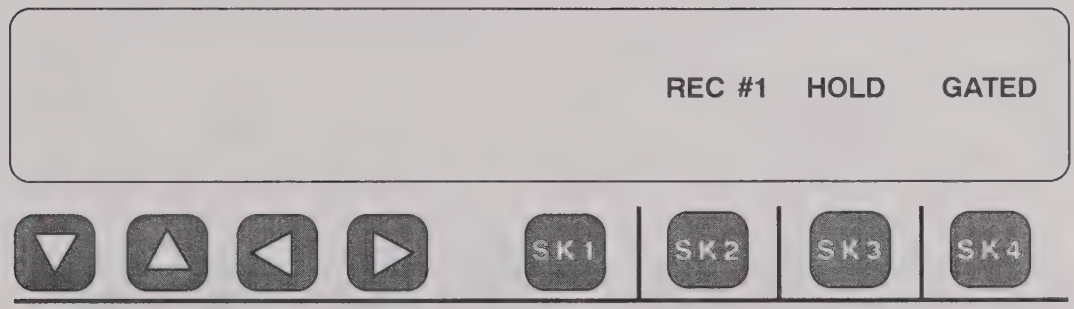
The examples which follow are intended to show you some of the basic types of calls a 930A can receive and analyze. The procedures for setting up the Digit Receiver are the same for all types. Once you know what type of digits to expect, and what the call sequence looks like, you can set the 930A accordingly. The Digit Receiver gives you so much flexibility that at times it may seem overwhelming. Once you get it set up, you can reduce all the flexibility to a few keystrokes by storing the Digit Receiver menu as a program using the **STO** key. Then all you have to do is **RECALL** that memory location (00 to 39) to bring back the Digit Receiver with your particular settings. In fact, you may want to store some of the example set-ups which follow. **The DIGIT RECEIVER is independent of the TRUNK TYPE you have selected.** This means that if you set-up the Digit Receiver to work on a Feature Group D call on a T-1 PCM Trunk, it will retain its settings, even if you switch to an E&M Type I Trunk. This saves you having to re-enter the settings once you have input them.



Press Softkey 4 to exit back to the main menu:

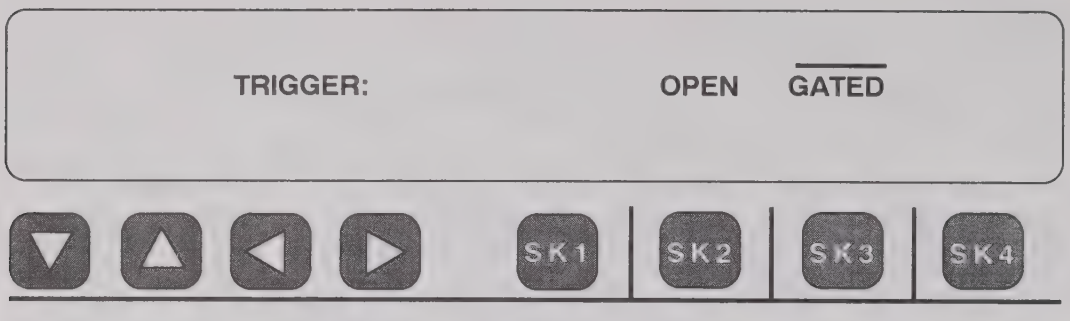


To receive the call and see the digits, press Softkey 2 (under **RECEIVE**) and the display should become:

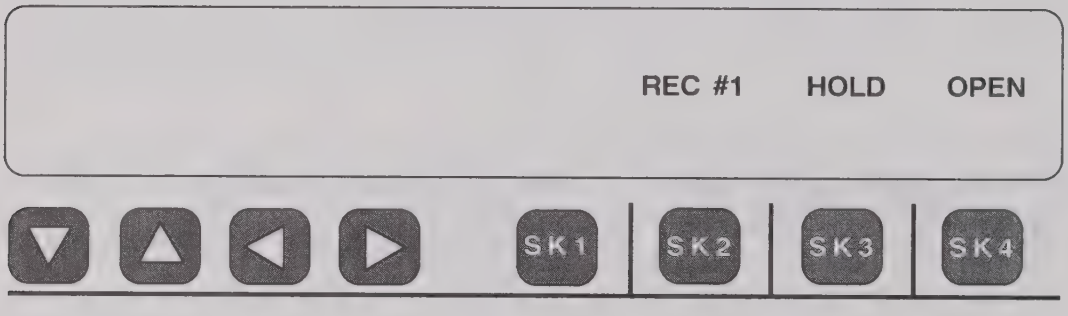


The 930A is waiting for the Trunk to be seized and digits dialed. When this happens, you should see them come across the display. Sometimes, it is necessary to disable the 930A supervision detection to get the digits.

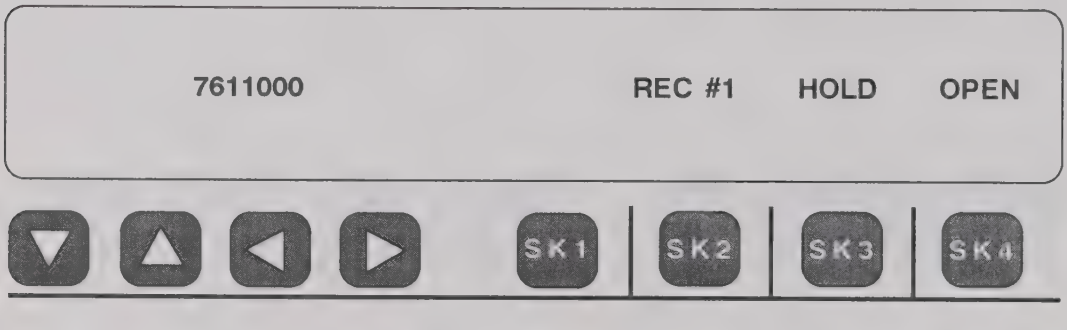
To ignore supervision, press Softkey 4 (under **GATED**) and the **TRIGGER** display, shown on the following page, will be presented.



Press Softkey 2 (under **OPEN**) to select the **OPEN** mode. The display will become:



One way or the other, you will see digits come across the display when they are dialed. In the **OPEN** mode, the display might look like:

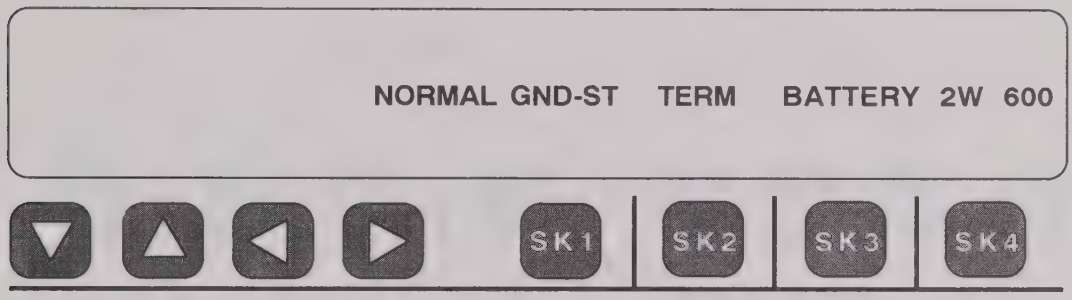


When receiving digits in the **OPEN** mode, you will have to ignore some of the "Errors" which will be displayed. **OPEN** is just what it says. This mode will make transients, speech and other things show up as "**E's**" before, in between and after, the digits you are capturing. In most cases you can ignore them and just look at the digits.

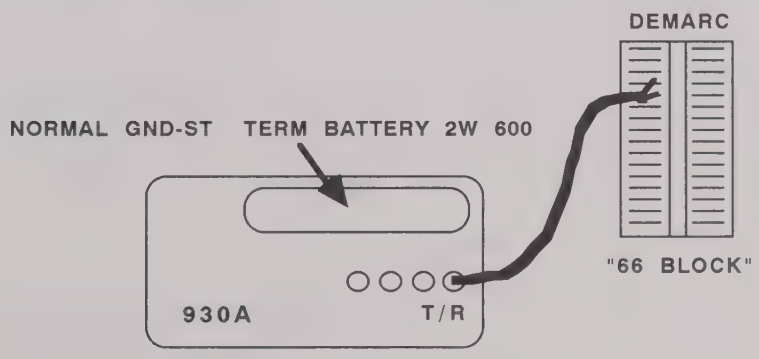
4-2.3 RECEIVING CALLS ON PBX GROUND START TRUNKS

For the GROUND START example we will show the 930A Terminating the Trunk. Remember that we could as easily follow the previous example to set the 930A Ground Start Trunk Type to Bridge mode.

Select the **NORMAL GND-ST** Trunk Type on the 930A and use the softkeys to change whatever appears on the display until it matches:



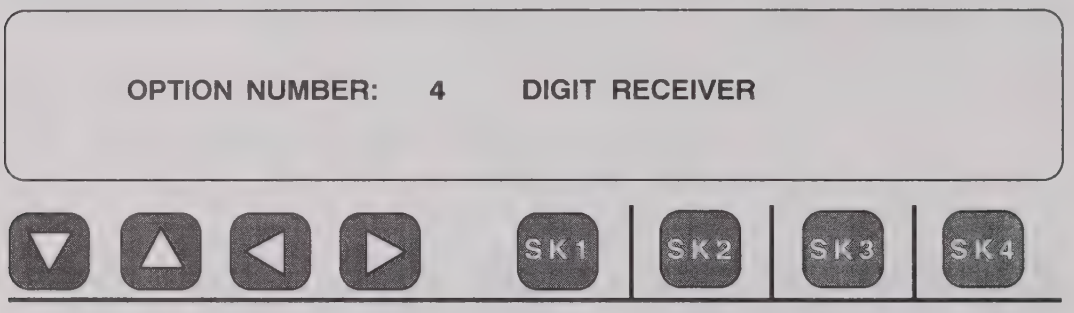
Again, this is a 2-wire trunk so the test cord connection at the **DEMARC** is the same as before **except** that now the Bridging clips have been pulled. This isolates the subscriber from the Central Office. From this point, the 930A can simulate either end to the other. For this example, the 930A will "look" toward the subscriber, simulate the Central Office, and supply Battery. The 310 to alligator clip test cord connection and 930A Trunk Type set-up is shown below:



The choice of 600 ohm impedance is a guess. It is either 600 or 900 ohms, and if the **DEMARC** point is not too far from the subscriber telephone set, then it is a good guess. Since we are only looking at digits, the choice does not really matter. It would matter more if we were analyzing the digits.

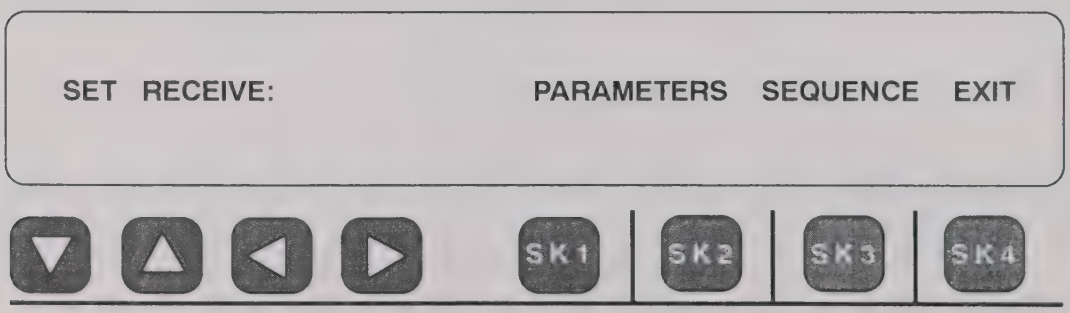
Once the test cord has been connected, check the front panel supervision LED's to make sure they both show **ON-HOOK** when the subscriber phone is **ON-HOOK**. If not, you may have to change the Trunk Type to **REVERSE GND-ST** to get the supervision correct.

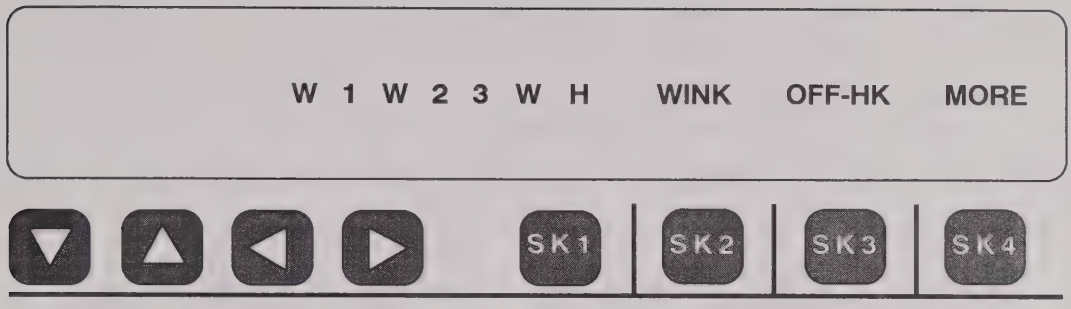
Now you can press the **OPTION MENU** key and go to Menu Option 4: **DIGIT RECEIVER**.



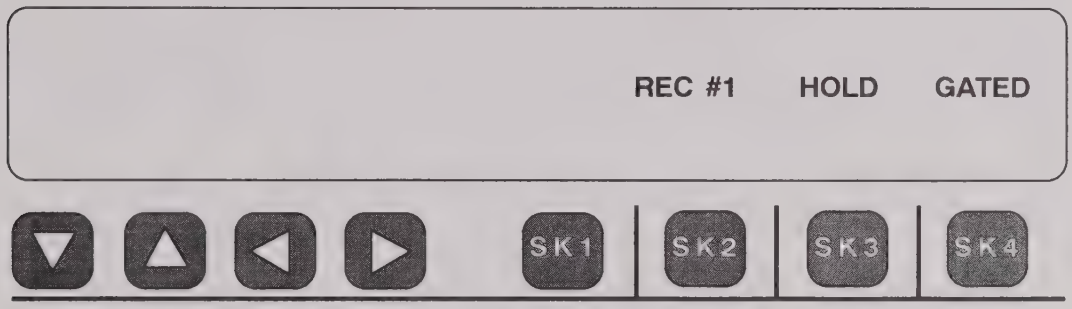
Press any softkey under the display and you get inside to the main menu:

Again, you have to get into the **SET-UP** menu first unless you have already set the 930A previously. **For this example**, assume that we want to capture some digits from a Dial Pulse or Rotary phone. For simplicity we can also specify it to be a 7 digit long number. After pressing **SET-UP:**





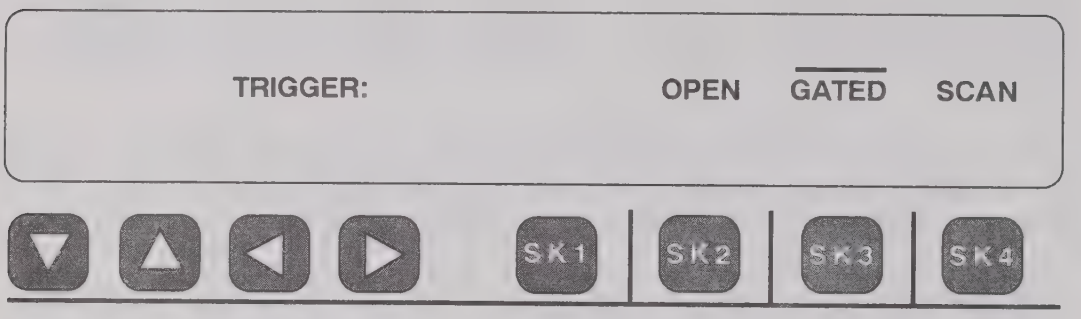
At this point, the receiver sequence is set up for a **three-stage, multi-wink, Feature Group D** call. Press the **OPTION MENU** key to return to the main menu and then press Softkey 2 to select **RECEIVE**. The 930A display will initially become:



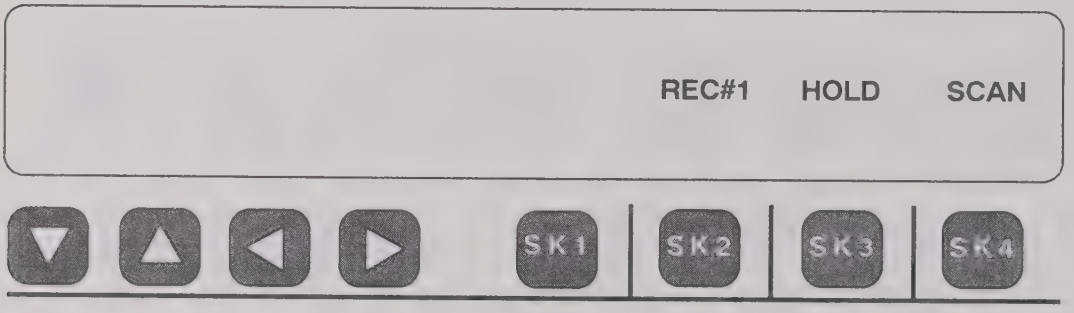
This is perfect if you have the luxury of being able to force the call to come in on the particular PCM Channel you happen to be set to. Since this is not usually the case, the 930A contains what amounts to a **"Bearcat Scanner"** mode. When activated, this mode enables the 930A to jump to the next PCM channel that goes active and capture the digits, regardless of what channel it was on before. This mode is described in the following paragraph.

4-2.4.1 USING THE DIGIT RECEIVER SCAN MODE

To activate the **SCAN** mode, press Softkey 4 (under **GATED** in the display on the previous page), and the **TRIGGER** display wil
appear:



The cursor is flashing over the previous selection which was **GATED**. Press Softkey 4 (under **SCAN**) to activate the **SCAN** mode. The display becomes:



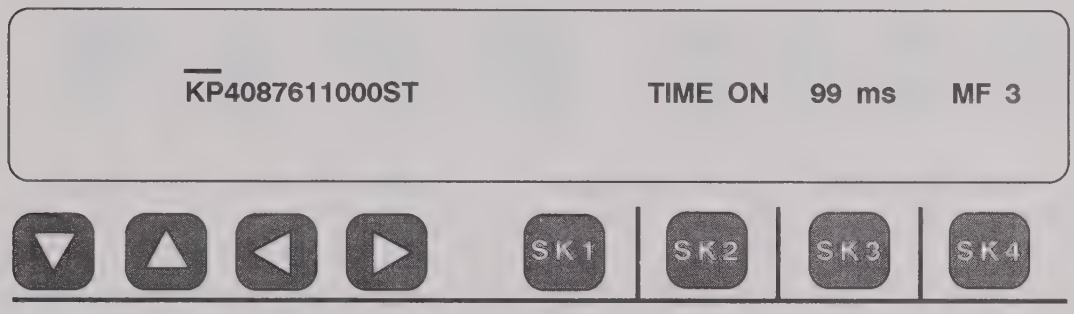
Do not worry if the display says REC#2 or #4 instead of **REC#1** because this is a random display until the Trunk is seized. The first group of digits becomes Record # 1 and so on.

The 930A will now jump to the next PCM Channel that goes **OFF-HOOK** and begin to capture digits. This saves you guessing which Channel to set the 930A to, and waiting for that channel to be seized.

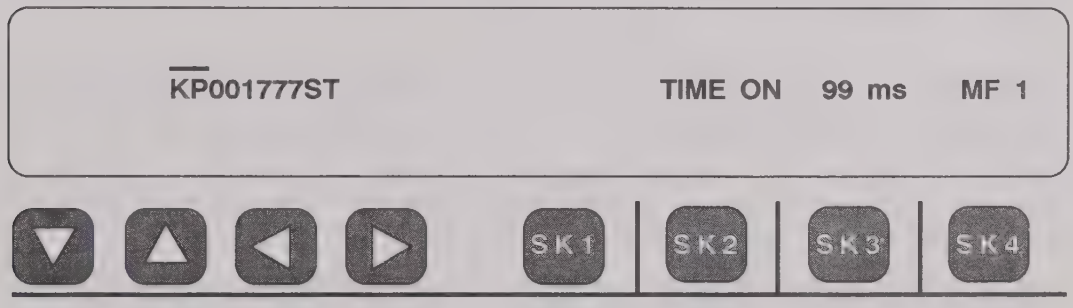
The SCAN mode only works with the 930A in PCM Trunk Type since there is no need for it on an analog Trunk.

After you have received the call sequence, press the **OPTION MENU** key to back out of the **RECEIVER**. Select the **ANALYZER** to review the digits as described in the previous examples.

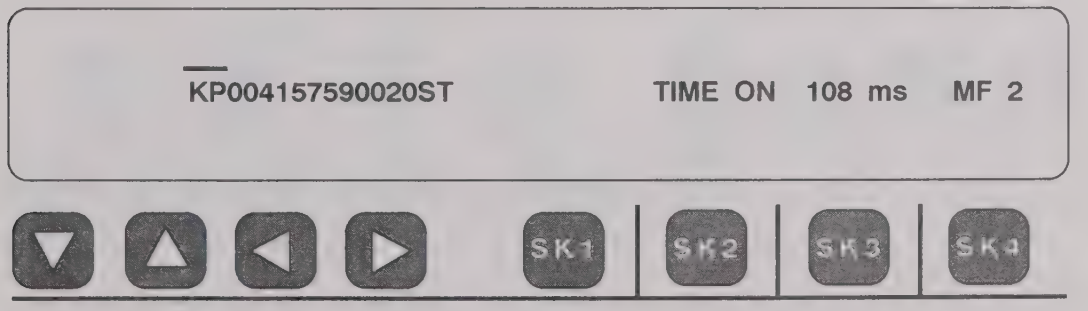
As an example consider a **Feature Group D MF** call sequence received under the **RECEIVE** function. After exiting to the primary receiver display and selecting **ANALYZE**, the 930A display shows the last Record it received first. **The Called Number** display example is:



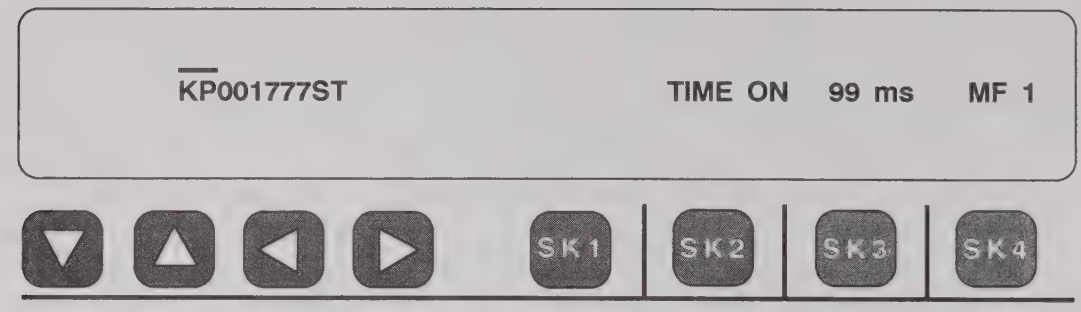
Press Softkey 4 to page through the Records to **MF Record 1**. This would be the **IC Code** and an example might be:



Press Softkey 4 again to page up to **MF Record 2** which would be the **ANI** (or the number from which the call was placed) in our example:



After a brief check of each Record you are ready to analyze each digit starting back with the first **KP** of **MF 1**.

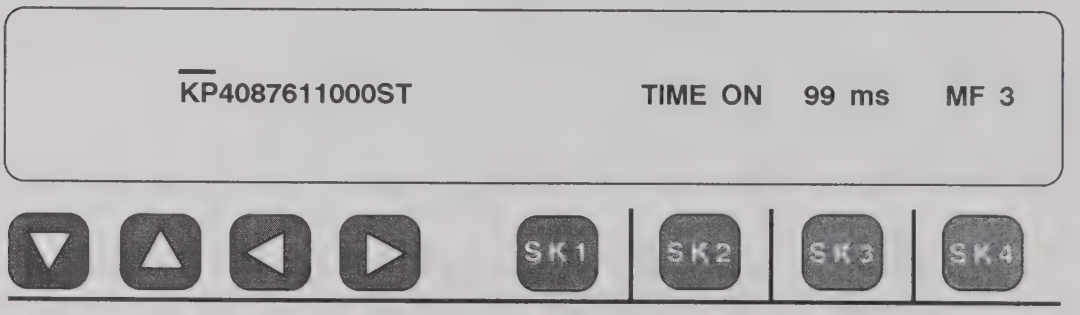


Pressing Softkey 2 will scroll you through all of the parameter measurements of the digit over which the cursor is flashing. It always starts over the first digit or **KP** in this case. Use the **RIGHT** Arrow key to move the cursor over the next digit (a **0** in this case) and then press Softkey 2 to scroll through it's parameter values. Repeat this process for any of the digits you are interested in.

Press Softkey 4 to go to the other received records and repeat the process to analyze their digits.

After you do this once or twice, you will appreciate the value of having a **Printer** connected to the 930A.

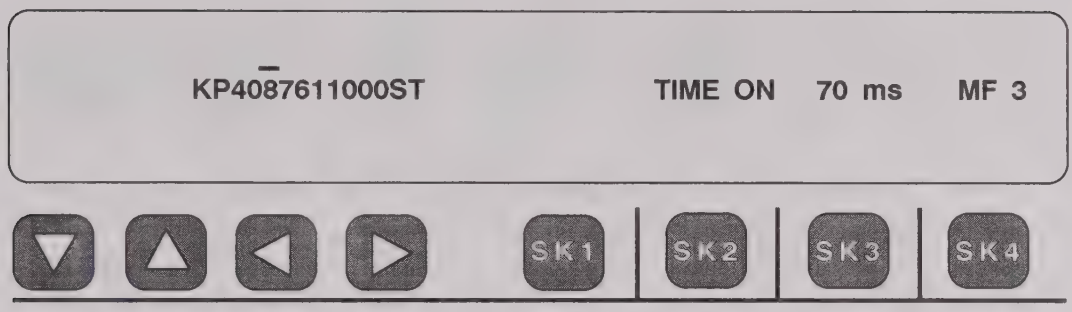
To get some idea of the digit analysis process, let us examine the "**8**" in the third **MF** Record (the **Called Number**) below:



The first step is to move the cursor over the "**8**".

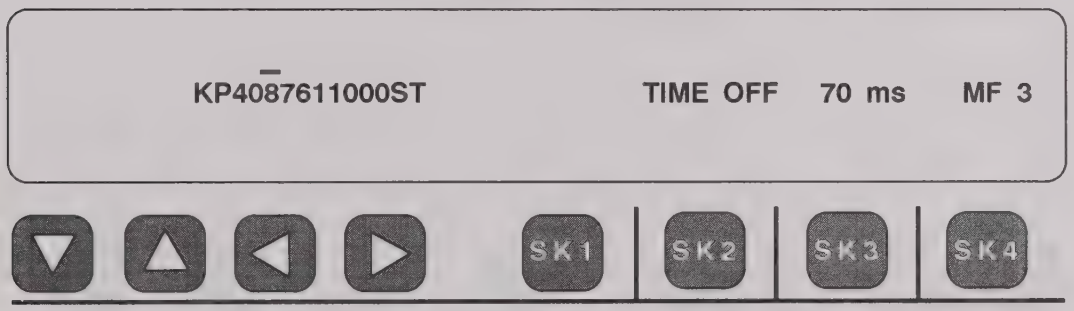
Use the RIGHT arrow key

to position the cursor over the "**8**"
and the display will change to:

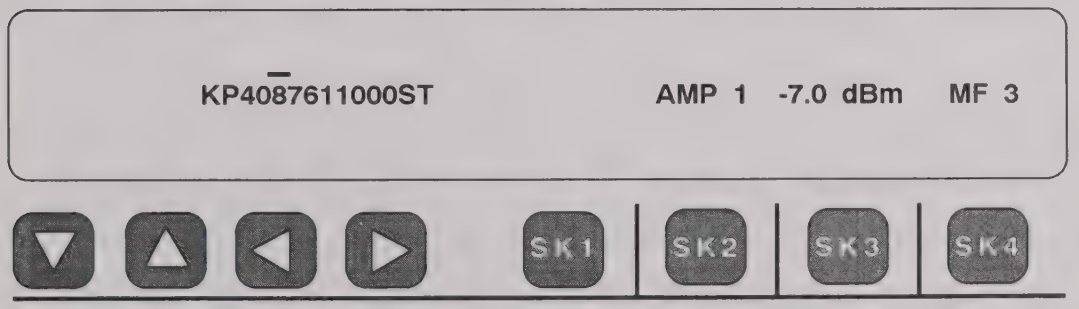


Starting with the **TIME ON**, you can go through the other parameters by pressing Softkey 2. A series of sample displays of each parameter follow:

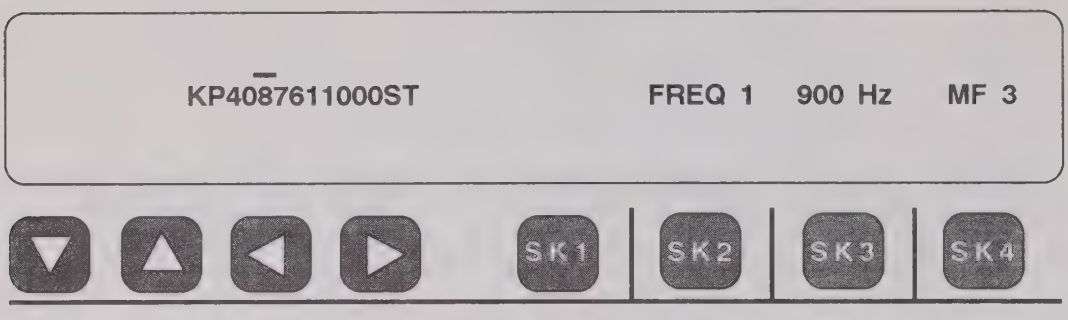
TIME OFF



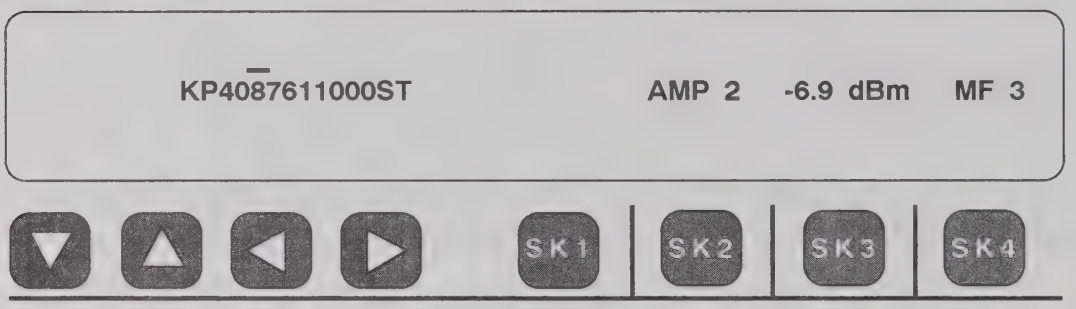
LOW TONE AMPLITUDE



LOW TONE FREQUENCY

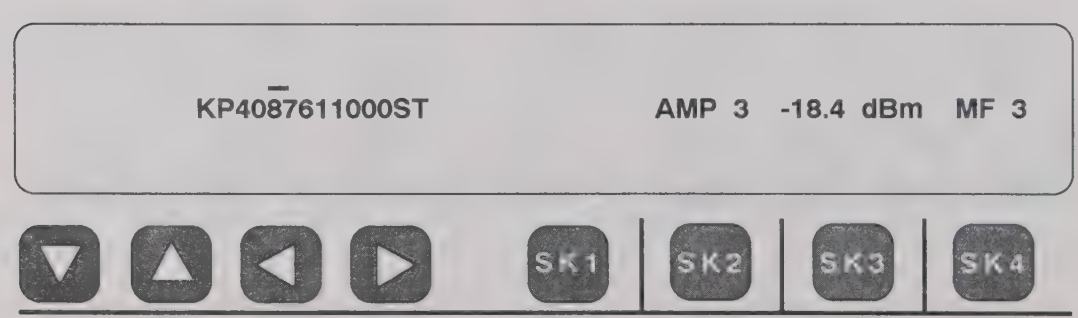


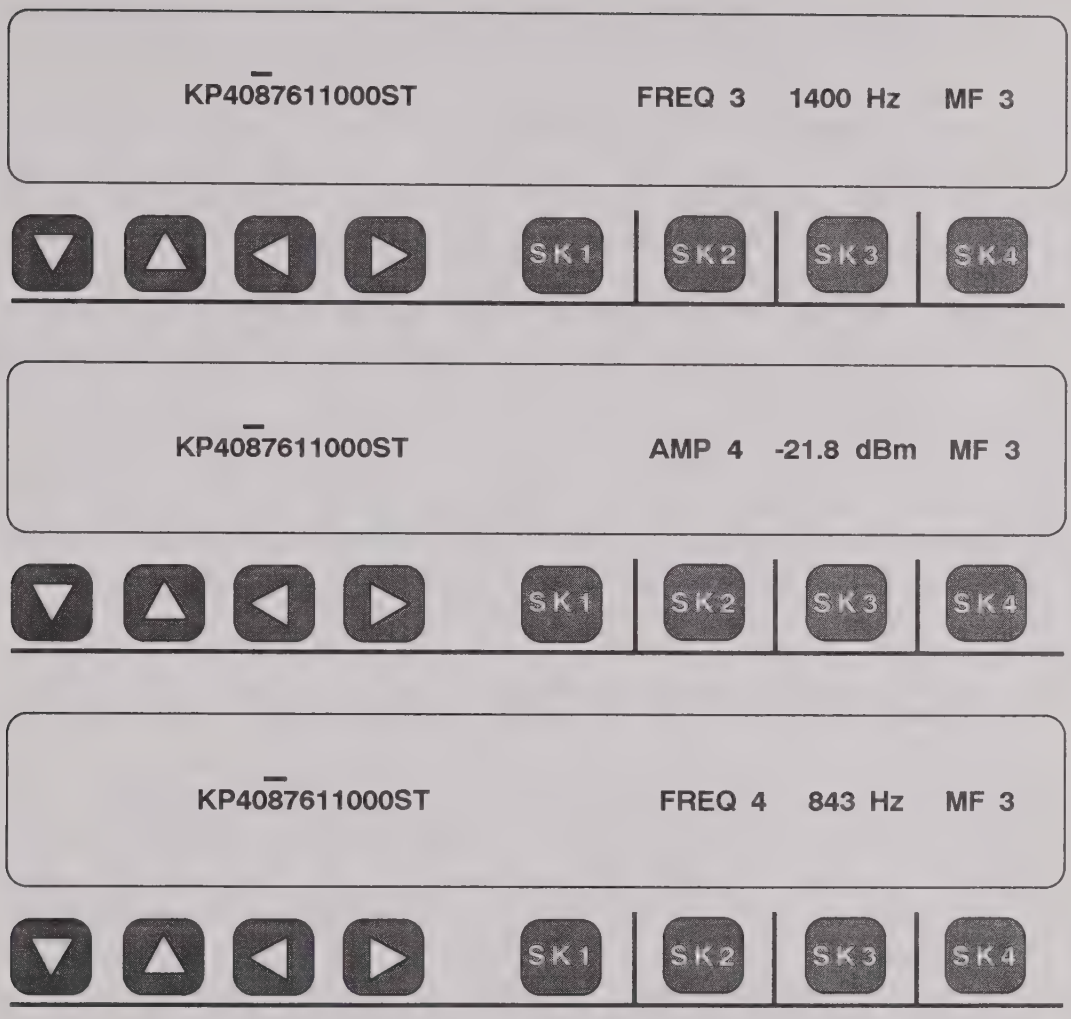
HIGH TONE AMPLITUDE



HIGH TONE FREQUENCY

If any spurious tones are present, the display would look somewhat like:





The Model 930A analyzes up to four tones in the **ANALYZER** mode. The first tone is the **Low Tone** of the **MF** or **DTMF** digit. The second tone will usually be the **High Tone** of the **MF** or **DTMF** digit. **Tones 3 and 4 will only** be displayed if spurious tones are present. These tones are not necessarily related to the normal High and Low tones of the digits. If there are no spurious tones present, the 930A will momentarily show the locations of these tones, but there will be no measurements and the display will immediately return to the **TIME ON** display.

You can also use the **UP/DOWN** Arrow keys to scroll through the various measurements, until returning to the starting point (**TIME ON**). **Remember** that under normal circumstances, there will be no display of a third or fourth tone. These are displayed only when spurious tones are present.

In actual use, the received digits will be less than perfect. In fact, some or all of the digits may be so badly mutilated that even the 930A will not be able to interpret them. In such a case, the 930A display will show an "**E**" instead of the received digit. Such displays are discussed in the example which follows.

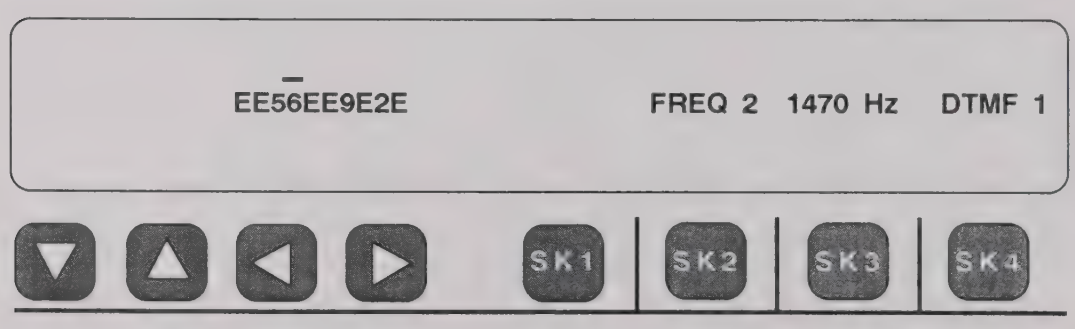
The nominal values of the MF, DTMF and DP digits are also listed.

Given the analyzing power of the 930A, it seemed like a good idea to provide you with some information on what the proper levels, frequencies, On/Off times, % Breaks, and Rates should be. You will be able to spot a bad reading when the 930A gives it to you. The information presented in this section comes from a number of sources including AT&T Practices and Bellcore Documentation. It applies to all Trunk Types, so there is no specific example of test set-up. Only the Digit Analyzer is described with the interpretation of it's readings. It is assumed that you have gone through the examples and are able to set up the Digit Receiver to capture digits.

4-2.6.1 EXAMPLES OF DIGIT ANALYSIS

When analyzing a string of received digits it is quite possible that some of the digits may be so badly mutilated that they are not recognizable. This can be caused by any number of things including; defective sending equipment, pressing two keys at the same time and causing more than two tones to be sent in **MF**, and weak **DTMF** keypad springs in older Touch-Tone phones, which distort the digits.

A typical display of distorted digits might appear as follows:



A number of the **DTMF** digits were so distorted the 930A put an "**E**" for Error in their place. If you know what digits were actually sent this may help to determine the cause of the problem. For instance, suppose that the string of

4-6 ROTL/RESPONDER/INTERROGATOR (OPTION 930A-12)

The Model 930A, when equipped with Option 930A-12, provides a test capability similar to the Centralized Automated Routining Of Trunks (**CAROT** or 52A) system in manual or remote control applications. The functions of a **Remote Office Test Line (ROTL)/Near End Responder**, **Far End Responder**, and **ROTL Interrogator** are contained under **Menu Options 25, 26 and 27**. These features are compatible with **AT&T Type 105 test lines. You can measure** 1004 Hz loss, noise, noise with tone, gain/slope, ERL, SRL-LO, and SRL-HI.

In addition, if you are testing toward a SAGE Model 356E Far End Responder, or another 930A equipped with Option 930A-12 and version 3.21 or above software, you can do the extended range of tests. These tests include: Signal-to-Noise, Attenuation Distortion, 3 KHz Flat Noise, P/AR, Intermodulation Distortion, Phase/Amplitude Jitter, Envelope Delay Distortion, Impulse Noise and Hits.

With Option 930A-10C, you can connect a printer to the 930A to obtain a hard copy of the test results.

4-6.1 USING THE 930A AS A TYPE 105 FAR END RESPONDER (MENU OPTION 25)

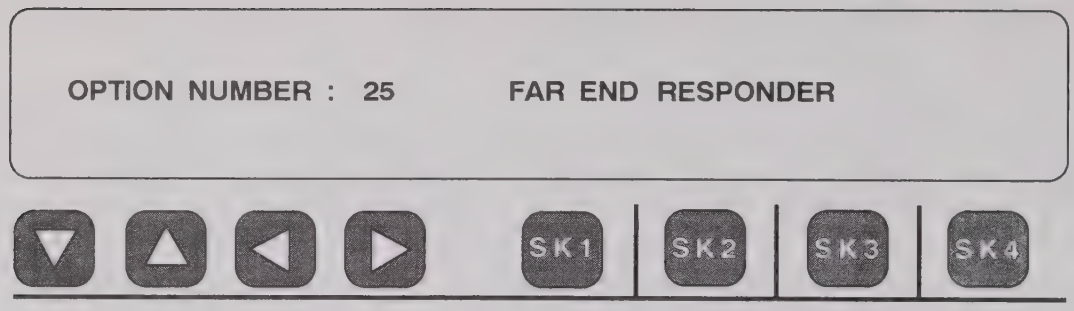
With Option 930A-12, you can configure the 930A as a Type 105 Far End Responder. The 930A can then be controlled by any CAROT compatible ROTL. You can measure Loss, Noise, Noise with Tone, Gain/Slope, and Return Loss. The 930A can be accessed over any of it's analog interfaces, or it can provide this function directly on a T-1 PCM channel.

Before testing, set up the **Trunk Type** (Refer to Section 3-4) and connect the 930A to the circuit. Once this has been accomplished, perform the following steps to place the 930A in Far End Responder mode:

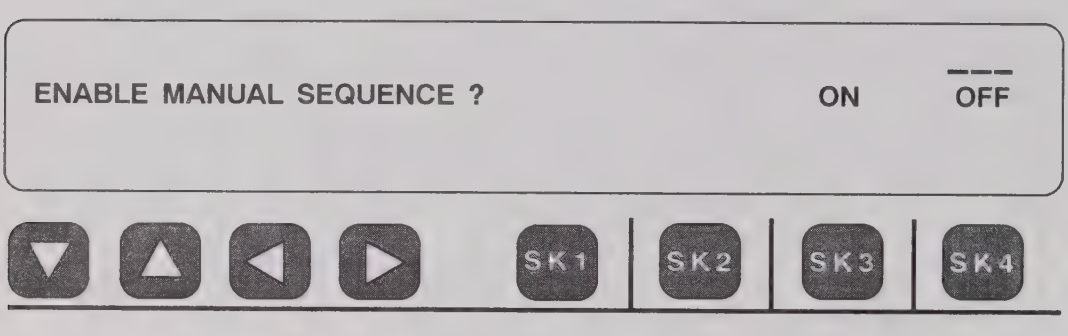
Press the Option Menu **Option Menu** key.

Use the UP/DOWN arrow keys

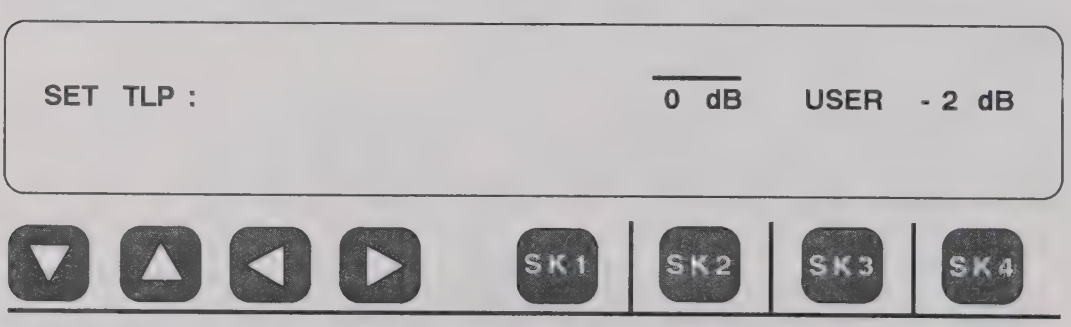
to select Menu Option 25: FAR END RESPONDER.



Press any softkey under the display and the 930A will ask the question:

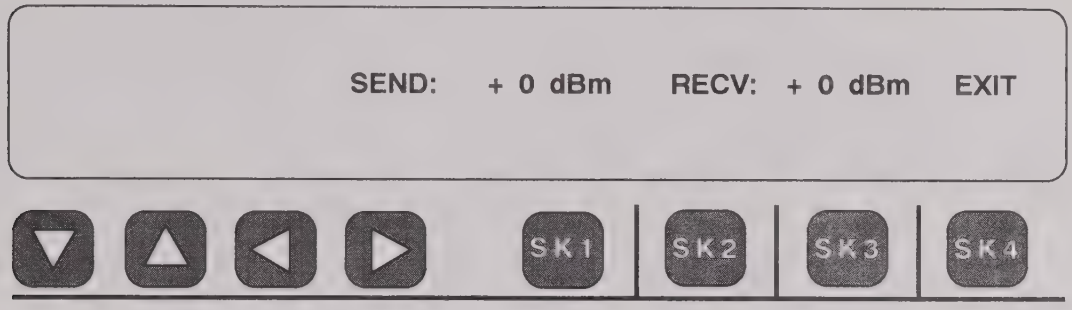


The Manual Sequence is normally **OFF**. You would press Softkey 4 (under **OFF**) and continue on with the **SET-UP**. The Model 930A always functions in the automatic sequence mode. The manual sequence just provides a means for performing single direction tests and is most useful for PBX testing. **If you want the manual sequence**, press Softkey 3 (under **ON**). In either case, the 930A will prompt you to set the **TLP** as shown below:

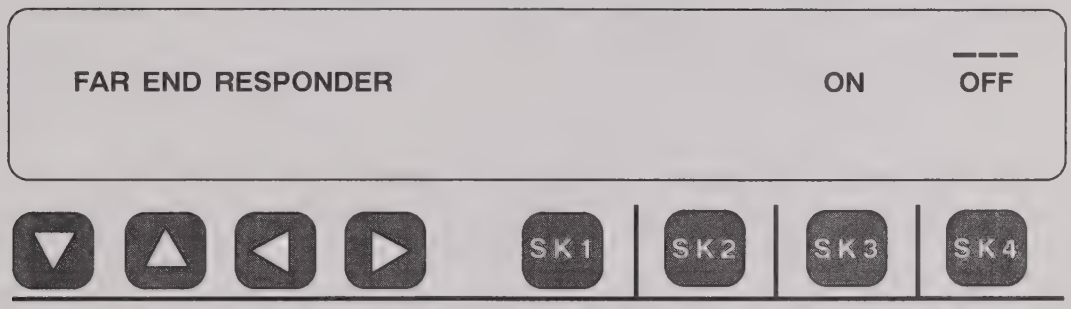


Press Softkey 2 to select 0 dB or **Softkey 4** to select -2 dB **TLP**. If -2 dB is selected, the 930A inserts a 2 dB pad into its input and output paths. **Press Softkey 3** under USER if you need to set a Send or Receive TLP value other than the standard 0 dB or -2 dB values.

If you press Softkey 3 under USER, then the display will change to:



To change the SEND TLP, press Softkey 1 and then enter the desired TLP using the keypad. Press ENTER to complete the selection. **To change the RECEIVE TLP,** press Softkey 3 and enter the desired TLP from the keypad. Press ENTER to complete the selection. When you have finished, press Softkey 4 to EXIT and the display changes to:



You turn on the **far end responder by pressing Softkey 3.** A cursor will appear over the **ON** indication. The 930A is now acting as a Type 105 Responder waiting to be accessed. The above display appears regardless of whether or not you choose the manual sequence. In either case, pressing Softkey 3 is necessary to enable the responder function.

When accessed by ringing, or far-end seizure, the 930A goes off hook and responds with a 2225 Hz test progress tone (**TPT**). The 930A then waits for **MF** commands and performs the corresponding Type 105 tests. The 930A will continue in this mode until:

a. It is released by the calling party via an MF "release" command.
b. The calling party goes "**On Hook**" (See Note).
c. No **MF** command is received for 20 seconds (930A defaults to Manual mode if selected).

d. The operator presses the "**OFF**" softkey, or any Function key on the 930A front panel.

When the 930A is released, or the calling party goes **On Hook**, the 930A goes On Hook for 1 second and then awaits seizure or ringing. If the 930A is allowed to time out (20 seconds without an **MF** command), it will either go **On Hook**, or initiate the manual test sequence (if selected).

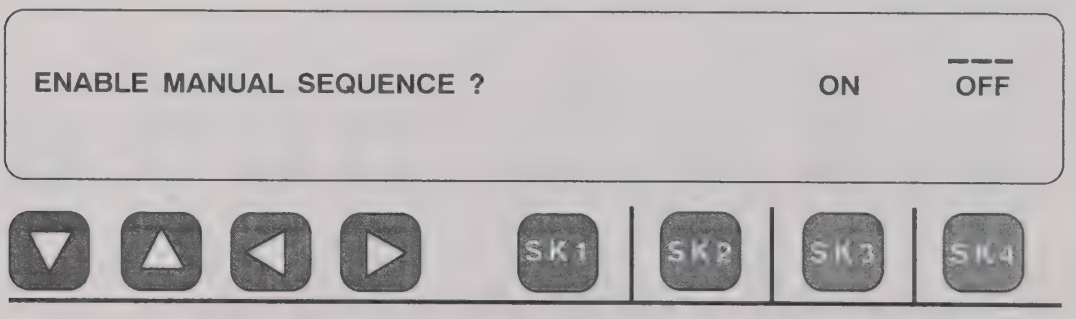
NOTE: If the 930A is on a **LOOP** trunk, simulating the subscriber (providing **CONTACT** rather than **BATTERY**), it will expect the far end to remain **On-Hook**, and will not treat this as a release condition.

For **PBX** testing, the manual mode sequence is most useful. If the Manual mode has been selected, the responder is allowed to time out (no **MF** command is sent) for 20 seconds or more. The Model 930A then provides the manual trunk test tone sequence shown below:

1. 9 seconds of 1004 Hz tone at -16 dBm0
2. 1 second of quiet termination
3. 9 seconds of 404 Hz tone at -16 dBm0
4. 1 second of quiet termination
5. 9 seconds of 2804 Hz tone at -16 dBm0
6. 30 seconds of quiet termination
7. Short burst of TPT (2225 Hz) signaling end of sequence
8. On-hook

If the manual test sequence is not enabled, the 930A will return to the **On Hook** state after a 20 second time out.

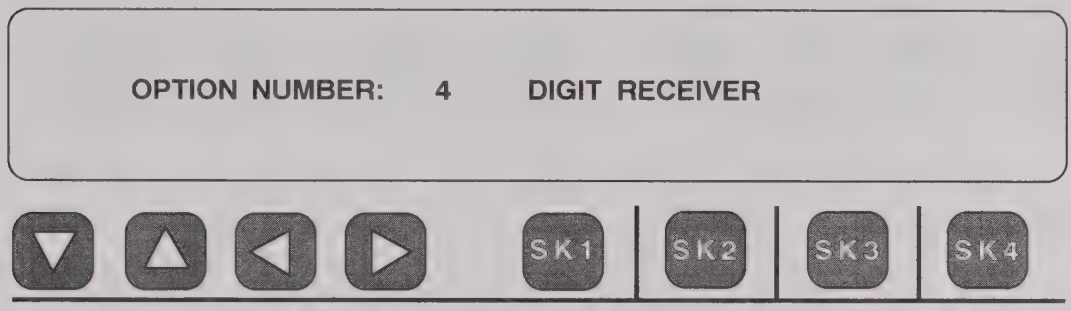
NOTE: To initiate manual testing, you must enable the Manual Sequence when the 930A display asks for the choice. That display is repeated below and shows **OFF** as the previous condition.



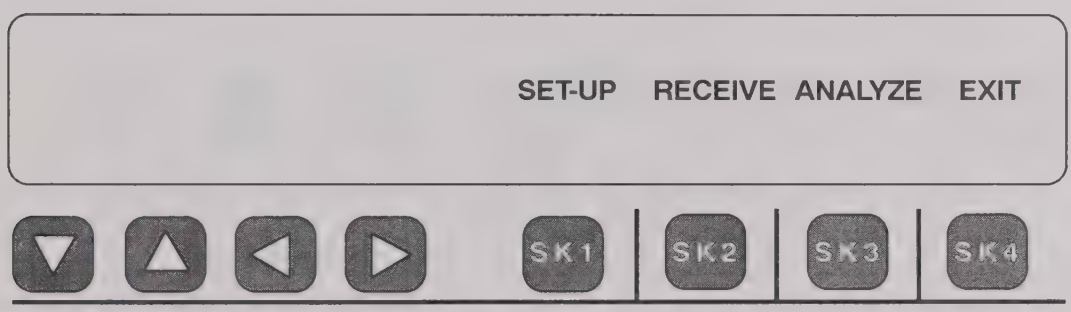
Press Softkey 3 to enable the Manual Sequence. **Press Softkey 4** if you do not want it.

4-6.1.1 RESPONDER TESTING USING THE DIGIT RECEIVER (OPTION MENU 4)

With Option 930A-12 and Option 930A-01: **Digit Receiver/Analyzer**, you can set the 930A to be a **Type 100**, **102**, or **105 Test Line** after a call sequence has been received. After you have set the 930A to the correct **TRUNK TYPE** (Refer to Section 3-4), you can proceed to the Digit Receiver. **Starting from Menu Option 4** below:



Press any softkey under the display and the main menu will appear:

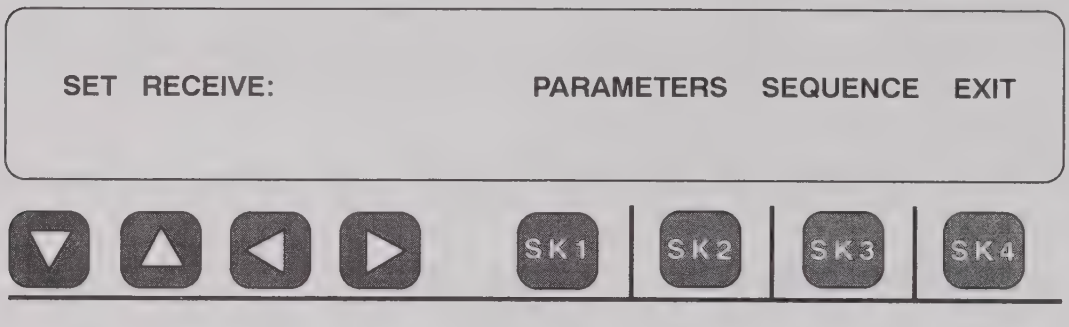


NOTE: To set a TLP other than the default value of 0 dB you must first set the TLP in Menu Option 25 before you set up the Digit Receiver to act as a far end responder.

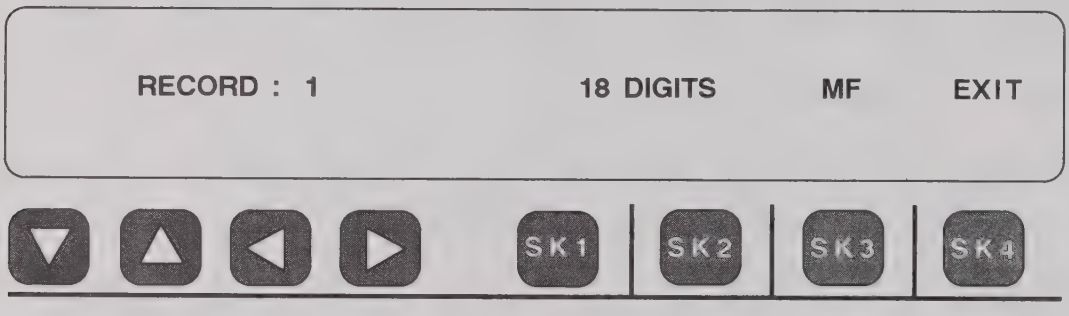
Remember, you have to set the Digit Receiver up for the expected call and it's parameters. Section 4-2 gives the details. For our purposes, an example will serve to illustrate the procedure for all cases.

For this example, we want the 930A to be a Type 105 Far End Responder after it receives a Touch-Tone (**DTMF**) call on a Wink Start Trunk.

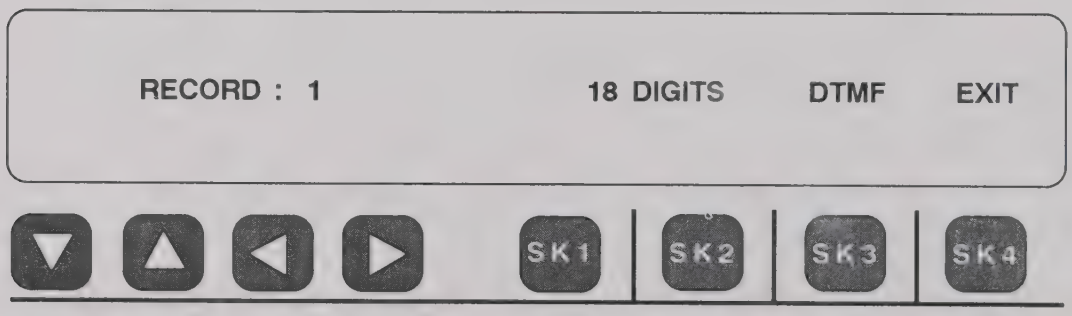
First, a single **DTMF** sequence on a Wink Start Trunk is expected. Press Softkey 1 (under **SET-UP**) in the previous display and the **SET-UP** menu will be displayed:



Press Softkey 1 (now under **PARAMETERS**). The display will show the previously entered settings. The 930A default display is shown for example:



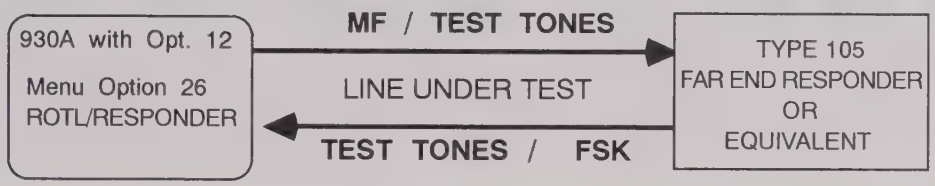
The parameters above must be changed to **DTMF** digits of the correct length. Press Softkey 3 (under **MF**) until **DTMF** appears as shown below:



Next, since this is a **DTMF** sequence, the correct length of the expected call must be entered or the 930A will wait for digits that will never come. A local call of 7 digits (no area code) length will do.

4-6.2 USING THE 930A AS A ROTL/NEAR-END RESPONDER (MENU OPTION 26)

With Option 930A-12, the Model 930A can also perform the functions of a **ROTL/Near-End Responder**. The 930A can access a 105 far-end responder and supply the **MF** signaling necessary to initiate Loss, Gain/Slope, C-message Noise, Noise with Tone, and Return Loss measurements. A typical connection is shown below:



The 930A can also access a SAGE Model 356E Far End Responder or another 930A and do the extended range of tests listed on page 4-77.

To set the Model 930A up as a ROTL/Near-End Responder, do the following:

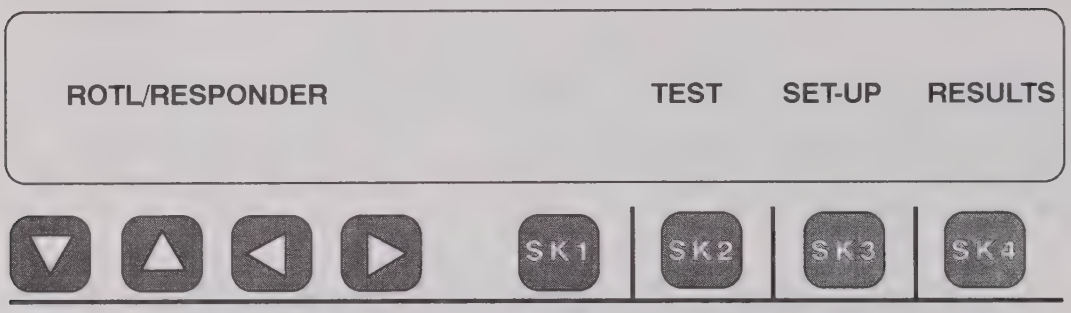
Press the Option Menu **Option Menu** key.

Use the UP/DOWN arrow keys

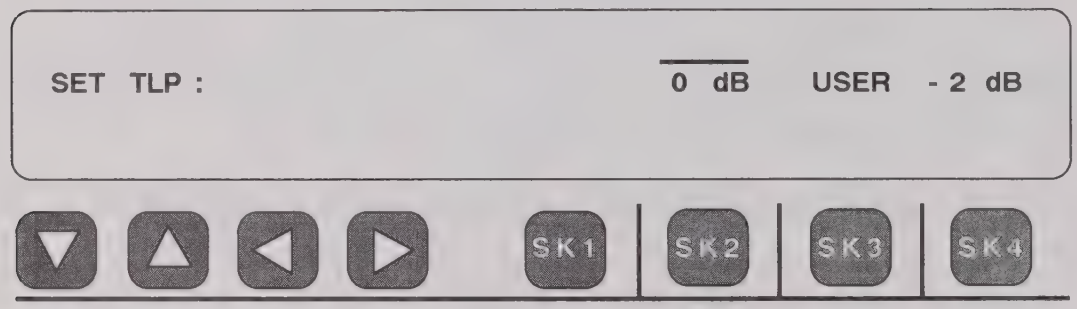
to select Menu Option 26: ROTL/RESPONDER.

The 930A display will appear as:

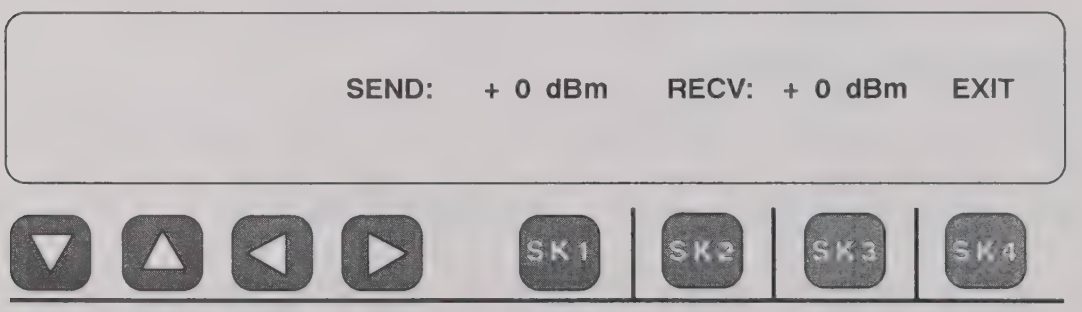
Press any softkey under the display and the main menu will appear:



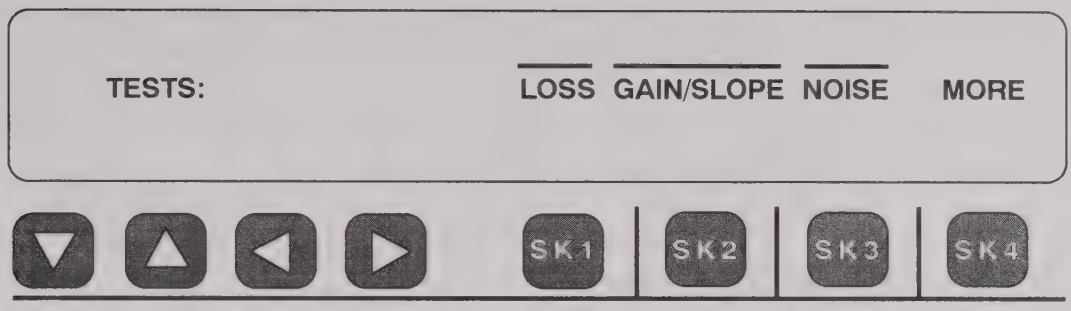
To begin, press Softkey 3 (under **SET-UP**). The 930A display changes to:



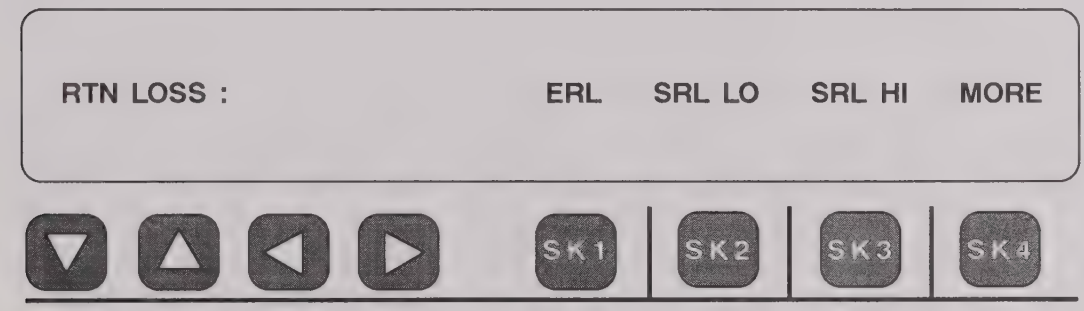
Press Softkey 2 if the set is connected at a 0 dB point, or **Softkey 4** if the set is connected at a -2 dB point. **Press Softkey 3 under USER**, if you wish to set Send or Receive TLP values other than 0 or -2 dB. The 930A display will then change to:



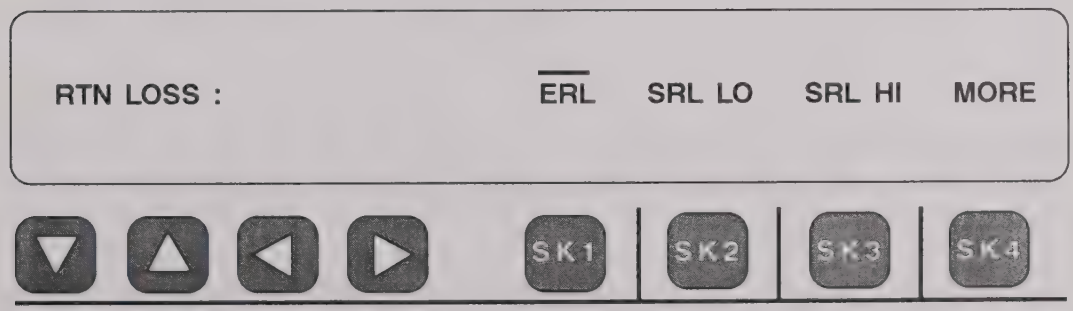
Press Softkey 1 to change the **SEND TLP**. The range is +7 dB to -25 dB. Use the keypad to enter your choice and press **ENTER** to complete the selection. **Press Softkey 3** to change the **RECEIVE TLP**. The range is + 7 dB to -16 dB. Use the keypad to enter your selection and then press **ENTER**. When you have finished press Softkey 4 under **EXIT** and the next display will appear.



Tests which have been selected are highlighted, as are all of the above tests. To select or de-select a test, press the softkey directly beneath the test. This will toggle between select and de-select. Pressing Softkey 4 (under **MORE**) will cause the 930A to display the next series of tests which are:



You can select any, or all, of the return loss measurements by pressing their associated softkeys. For example, if you want to do the Echo Return Loss measurement, press Softkey 1 (under **ERL**) and a cursor will appear over **ERL** on the 930A display as shown below:



You may also select **SRL-LO** and/or **SRL-HI**. **Return Loss testing** is not standard in all far-end responders. If you get a far-end "**failed**" response

from the 930A, you will know the far-end does not have Return Loss capability. Press the **OPTION MENU** key to return to the main menu and begin testing toward standard responders. If you are testing toward a SAGE Model 356E Far End Responder or another 930A, you may press Softkey 4 under **MORE** to select additional tests.

The standard code 105 transmission tests which can be performed by the 930A are briefly described below:

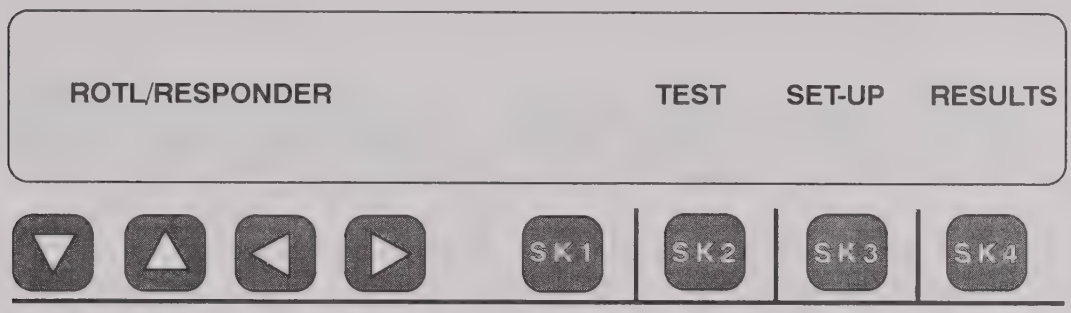
1. **LOSS** tests the two-way loss at 1004 Hz, 0 dBm.
2. **GAIN/SLOPE** tests the two-way loss at 404 Hz, 1004 Hz, and 2804 Hz. All tone levels are at -16 dBm.
3. **NOISE** tests **C-Message** noise in both directions and tests two-way **C-Notch** noise using a -16 dBm, 1004 Hz holding tone.
4. **ERL, SRL-LO and SRL-HI** tests the two-way **return loss** for each of the three types.

The enhanced responder transmission tests also include the following:

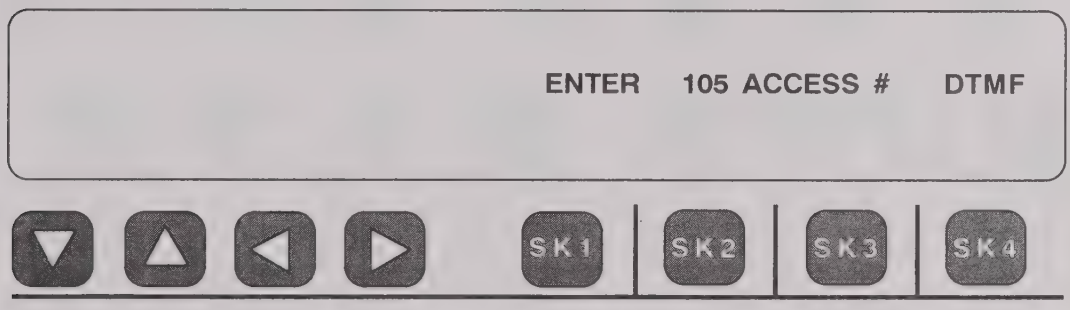
5. **FREQ SWP** tests two-way attenuation distortion.
6. **S/N** tests two-way signal-to-noise ratio.
7. **3K FLAT** tests 3 KHz flat-weighted noise in both directions.
8. **P/AR** tests Peak-To-Average ratio in both directions.
9. **INTERMOD** tests two-way 4-Tone Intermodulation Distortion.
10. **JIT HI** tests phase and amplitude jitter in 20-300 Hz band in both directions.
11. **JIT LO** tests phase and amplitude jitter in 4-300 Hz band in both directions.
12. **EDD** tests Forward and Return Reference Envelope Delay.
13. **IMP/HITS** tests three-level Impulse Noise, Phase Hits, Gain Hits, and Dropouts in both directions. Test length and other parameters are user selectable.

Once you select the tests you want, the set-up phase of the test procedure is finished. This need not be repeated unless the **TLP** changes, or different tests are wanted.

Press the OPTION MENU key, or Softkey 4 under EXIT, to get back to the main menu and the 930A display will return to:

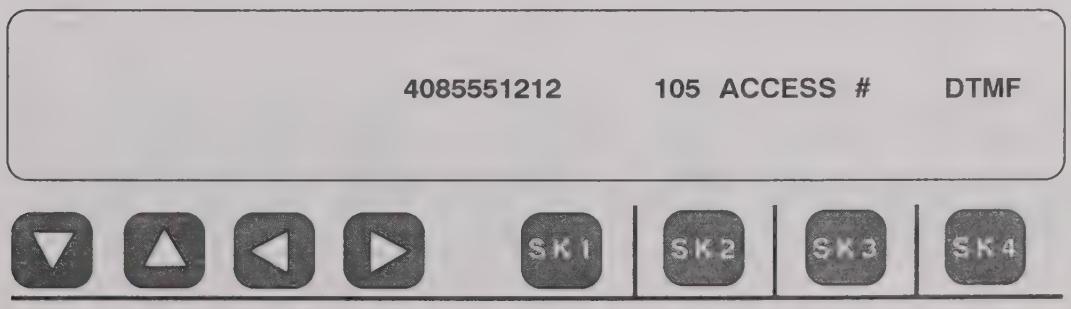


To begin the test procedure, press Softkey 2 (under **TEST**). The 930A display will change to the following:



The digit sequence may be **DP**, **MF** or **DTMF**. You select the appropriate type of signaling using Softkey 4. In the example above, **DTMF** outpulsing has been selected.

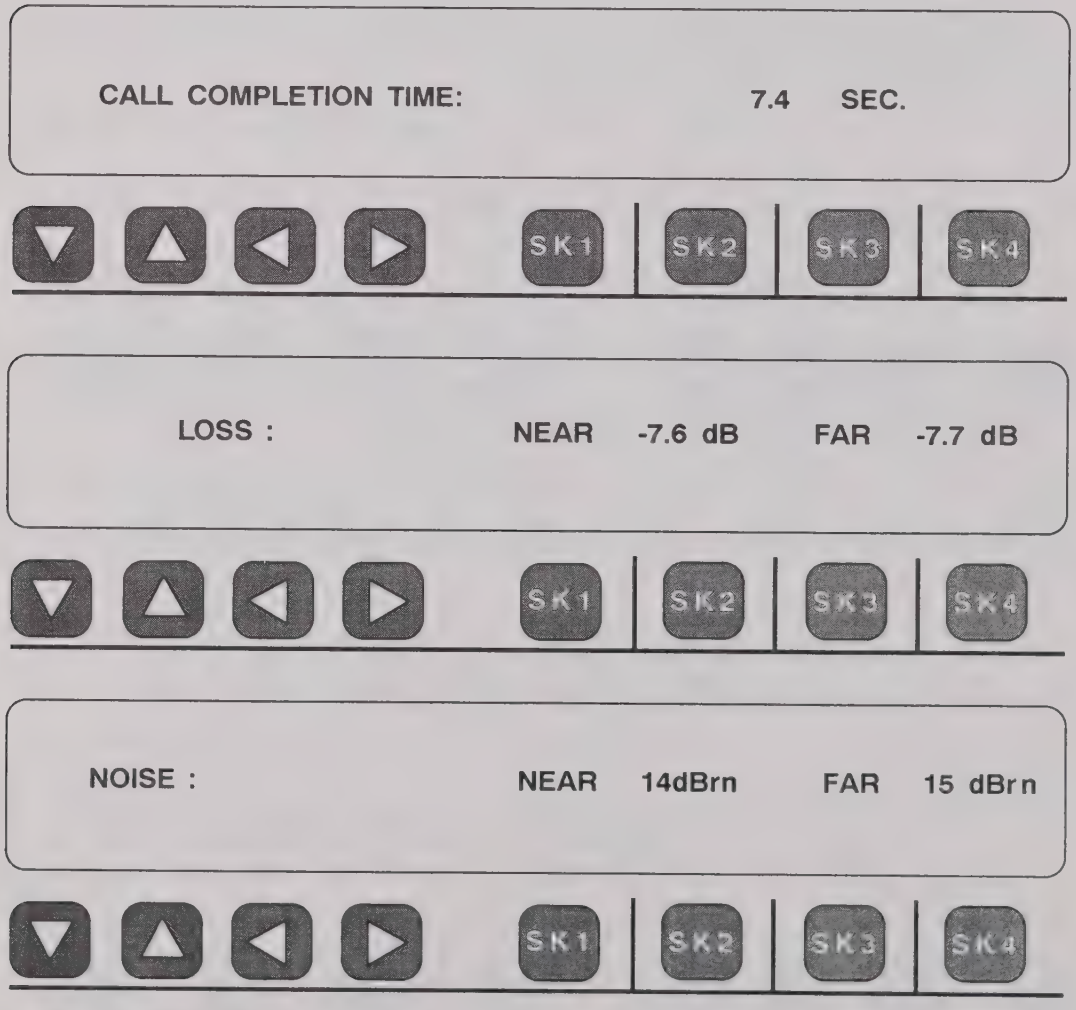
Now enter the phone number of the far end test line using the numeric keypad. An example of a **DTMF** phone number is shown below:

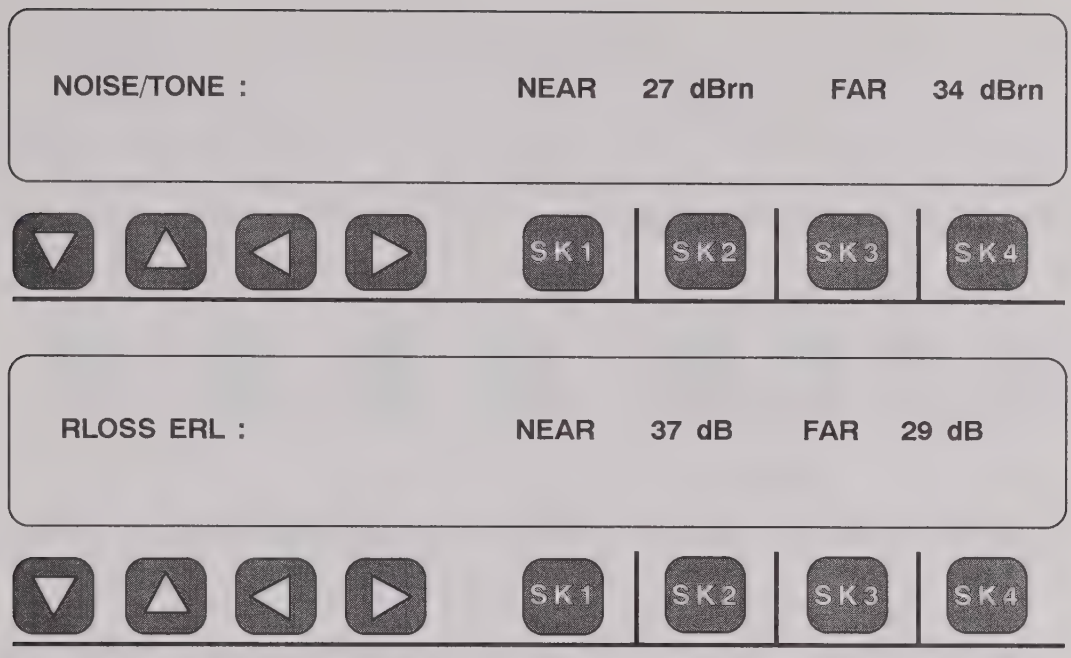


After you have entered the correct phone number, place the front panel hook switch in the **OFF HOOK** position to seize the line and send the call. When the far end has been accessed, you will hear a series of test progress tones as the 930A goes through the series of tests which were programmed.

For example, if you had selected only Loss, Noise and Noise with Tone, and Echo Return Loss measurements, the following series of displays would be shown on the 930A as it performed each measurement.

Notice that Call Completion time is measured first. For this example, typical displays might be:

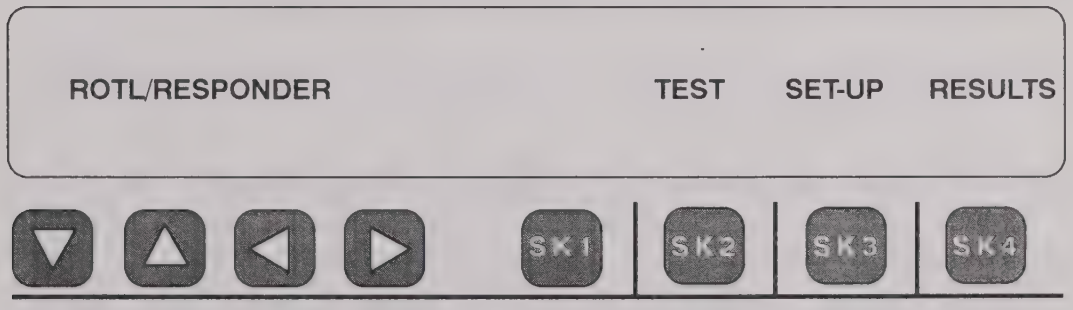




The **NEAR** results equate to **Far-to-Near** results given by CAROT. Similarly the **FAR** results equate to the **Near-to-Far** results.

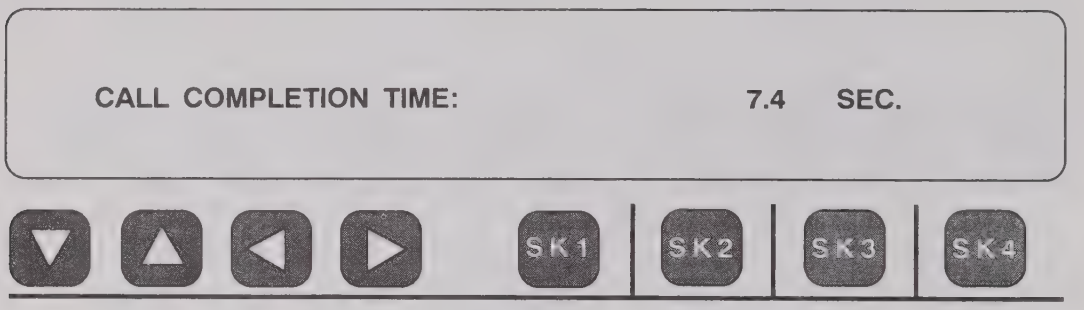
The 930A sequences through these tests and flashes the results briefly. The results are also stored in battery-backed **CMOS RAM**. If a printer is connected, the test results will be printed out as they occur. Once the sequence of tests has been completed the 930A releases the far-end responder.

At the end, the 930A returns to the main display shown below:

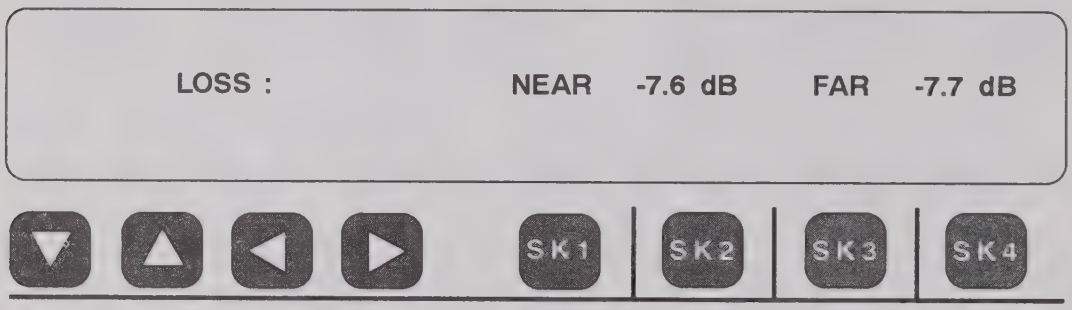


To view the results of the tests (which were flashed by at a reasonably rapid rate during testing), press Softkey 4 (under **RESULTS**). The 930A will recall the stored results of the previous test sequence.

In the previous example, after pressing Softkey 4, the **CALL COMPLETION** test results would have appeared as:



You can then use the **UP/DOWN** arrow keys, or Softkey 1 to scroll through the various test results. For instance, pressing Softkey 1 would bring up:



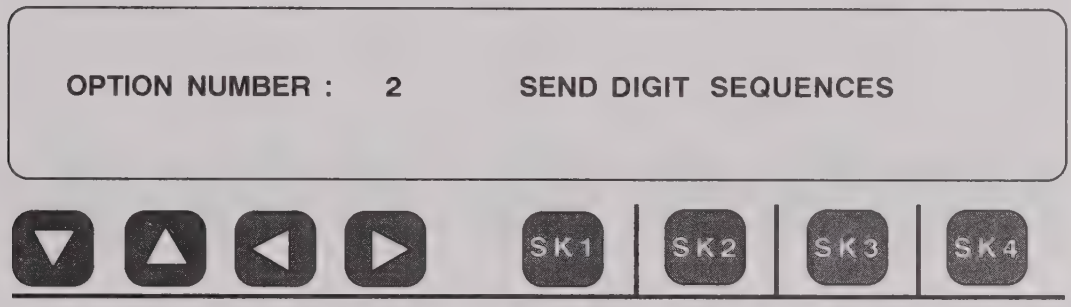
Continued pressing of Softkey 1, or the arrow keys, would enable you to review all of the test results in a convenient manner. The results are retained in memory until a new series of tests is begun and the old results are overwritten. **Press** the **Option Menu** key, or any front panel function key, to return to the main **ROTL/RESPONDER** menu display.

4-6.2.1 ROTL/RESPONDER TESTING USING SEND DIGIT SEQUENCES (MENU OPTION 2)

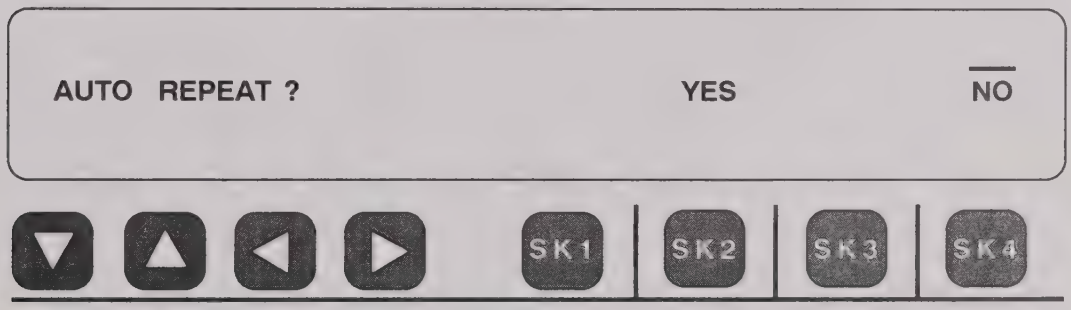
Option 930A-12 also enables you to operate the manual **ROTL** test function from **SEND DIGIT SEQUENCES,** Menu Option 2. This enables you to insert Winks or even place a Multi-Wink type call to initiate **ROTL** testing.

First, set up the **ROTL/RESPONDER** in Menu Option 26 as described in Section 4-6.2. **This selects the TLP and tests** which are desired. When this has been accomplished, you have the choice of sending the Far End

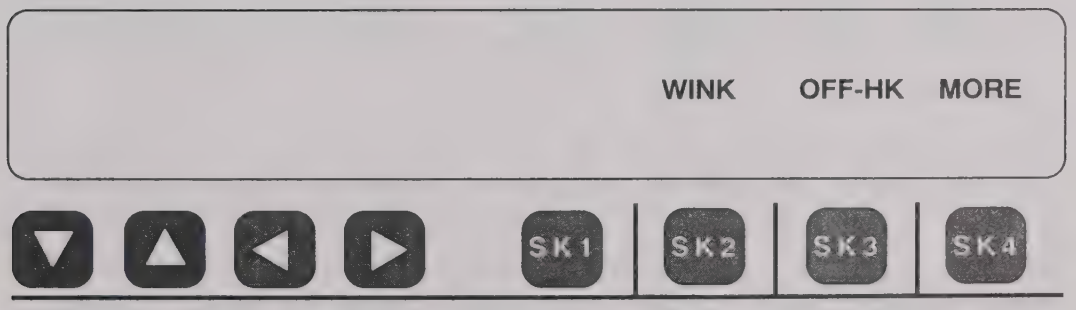
Responder's number from the **ROTL/RESPONDER** (Menu Option 26) or going to **Menu Option 2: SEND DIGIT SEQUENCES** to send it. In some cases, there are points in the telephone network where it is essential to be able to send a Multi-Wink sequence in order to complete a call. In such instances, you would place the call to the Far-End Responder from the **SEND DIGIT SEQUENCES** menu. **Begin** at Menu Option 2: **SEND DIGIT SEQUENCES**. This display is repeated from Section 3-10.3.1



Enter the menu by pressing any softkey under the display and it becomes:

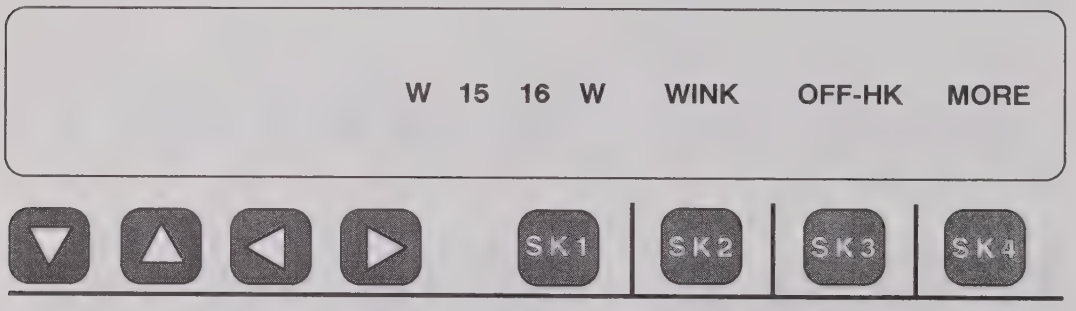


Press Softkey 4 (under **NO**) to send the call sequence once and the display changes to:



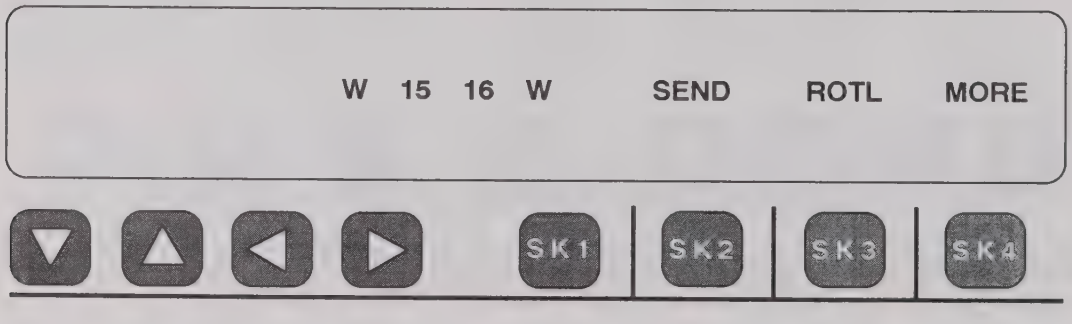
If any previously entered sequences are displayed, press the **CLEAR** key to obtain the above display.

As an example, simulate an Equal Access call sequence. This sequence will consist of two **MF** records: the **ANI** or calling number, and the **called number** which will be the test line's number. These two numbers will be stored in memory locations 15 and 16 using the procedure outlined in Section 3-10.3.1. After the winks and the two numbers have been correctly entered, the 930A display will look like the one below:

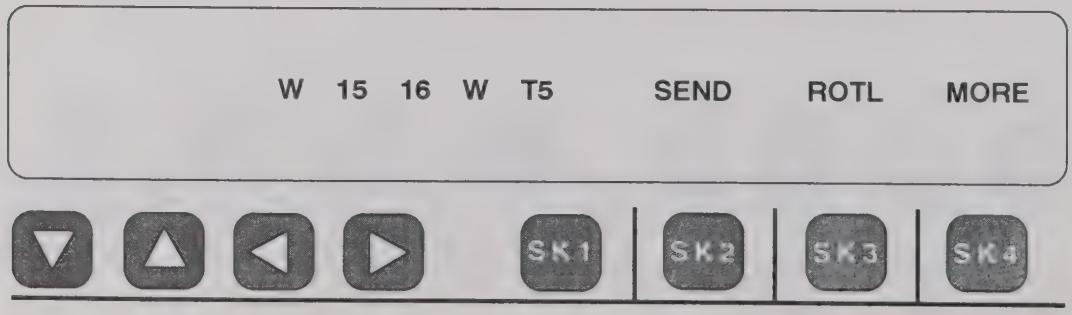


After entering the Feature Group D call sequence, the next step is to tell the 930A to become a manual **ROTL/Near End Responder** so that it will commence testing after the call completes.

Press Softkey 4 (under **MORE**) until the 930A display is identical to:

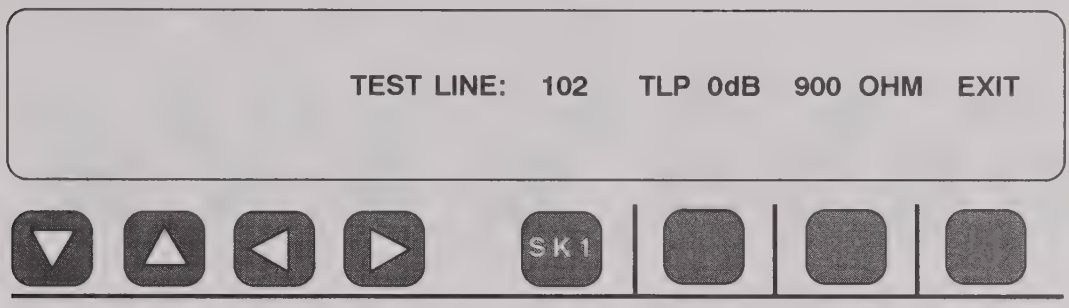


You will need to place the **ROTL** function at the end of the sequence by pressing Softkey 3 (under **ROTL**). The 930A display will become:

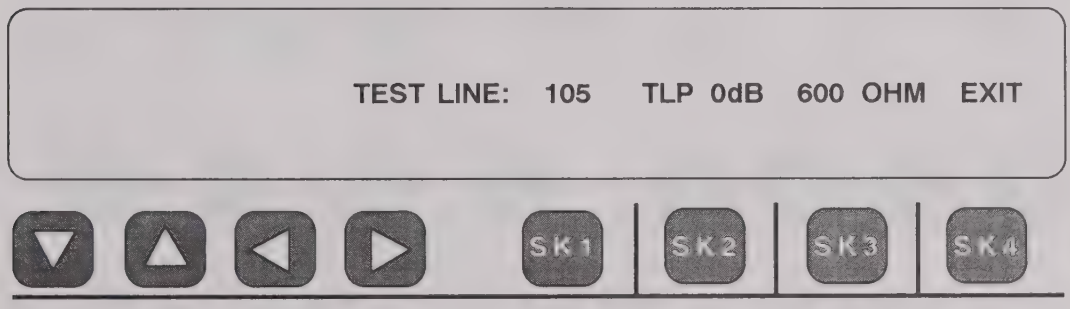


4-6.3.2 RESPONDER CONDITIONING SET-UP

After the priming digits have been entered, press Softkey 4 (under **EXIT**) to advance to the responder conditioning set-up display. A typical display is shown below:



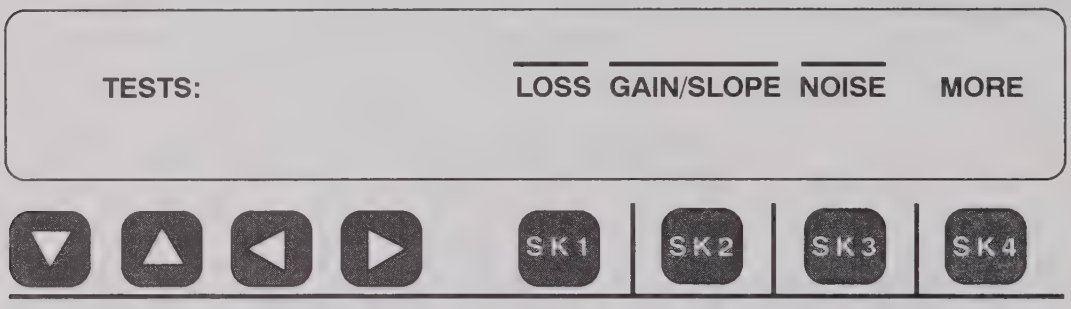
Softkey 1 selects the type of far end test line the **ROTL** will be calling. The choices are Type 100, 102 or 105. **Softkey 2** selects the near end responder Transmission Level Point (**TLP**). The choices are 0 dB or -2 dB. **Softkey 3** selects 600 ohm or 900 ohm impedance for the trunk under test. For example, assume that the far end test line is a Type 105. The trunk under test is a 600 ohm circuit with a **TLP** of 0 dB. **To change the set-up** above, press Softkey 1 until the test line type shows '**105**'. Press softkey 3 to change from 900 to 600 ohms. The 930A display now appears as:



Press Softkey 4 (under **EXIT**) to move on to the test selection set-up display.

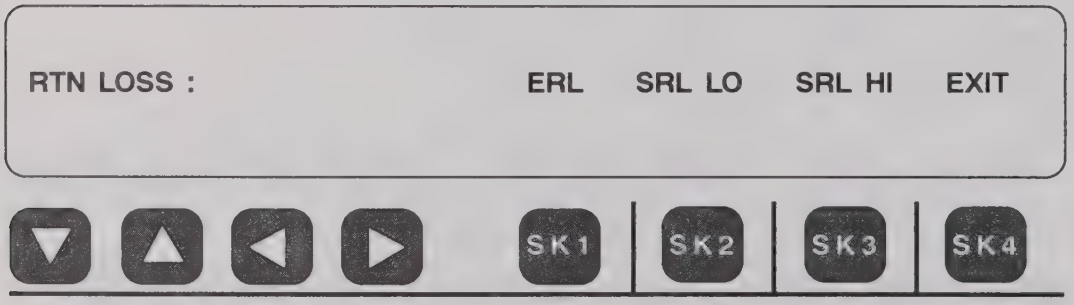
4-6.3.3 INTERROGATOR TEST SELECTION

The test selection display is shown below:



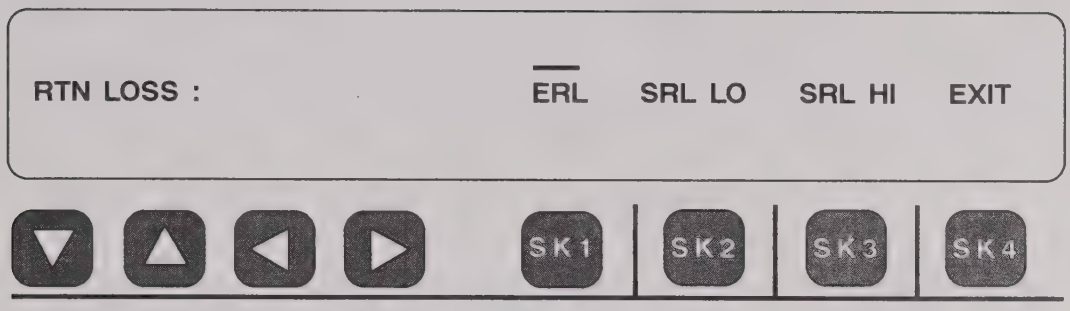
To select or de-select a test, press the softkey beneath the test. Tests which are selected will have a cursor over them, de-selected tests will not. **For two-way transmission testing** (Type 105), all tests would be selected. **If balance, or operational, testing** were being performed, **none** of the transmission tests would be selected. Press Softkey 4 (under **MORE**) to continue the selection process.

Pressing Softkey 4 (under **MORE**) brings up the following display:



Notice that **none** of the return loss tests have previously been selected. Many test lines do not support return loss testing or support only Echo Return Loss (**ERL**). Assume that the Type 105 test line being accessed has **ERL** capability. Press Softkey 1 (under **ERL**) to select **ERL** testing. Leave the other Return Loss tests de-selected.

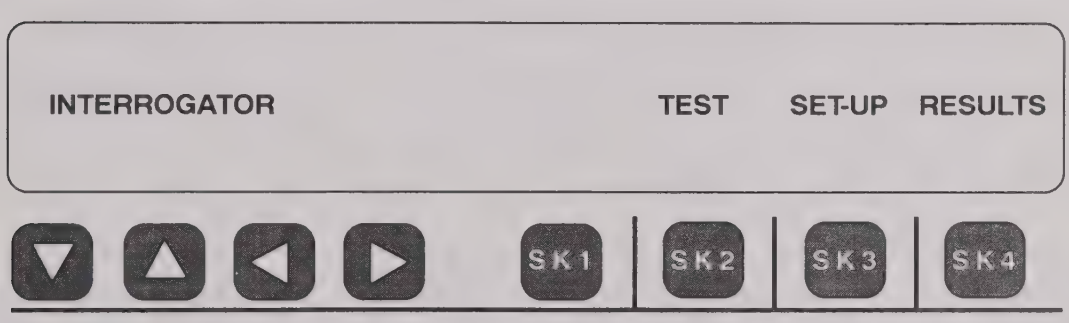
The 930A display will be:



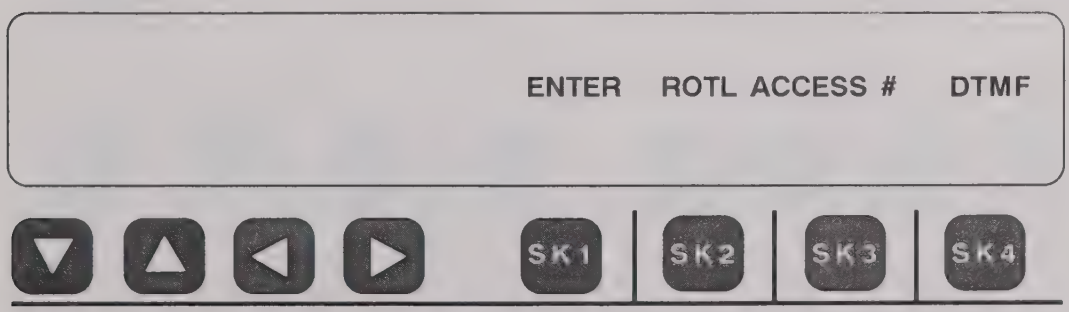
Now that the **INTERROGATOR** function is set, press Softkey 4 (under **EXIT**) to return to the main Interrogator menu.

4-6.3.4 TESTING WITH THE INTERROGATOR FUNCTION

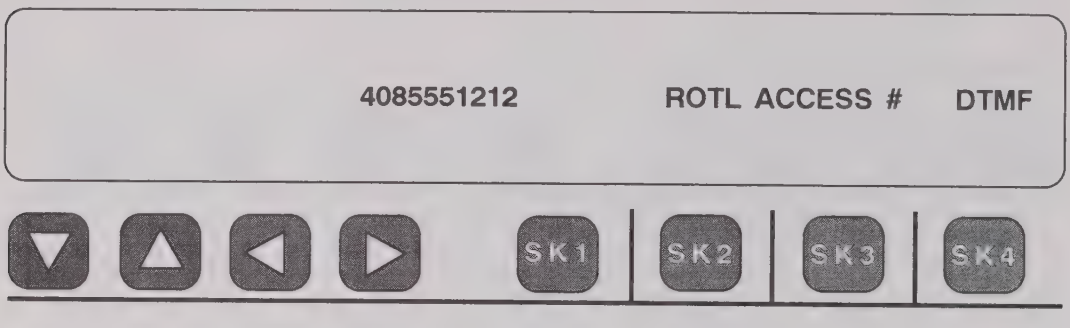
The main Interrogator display is shown below for discussion purposes.



To begin testing, after you have set the Interrogator up, press Softkey 2 (under **TEST**). The 930A display will then change to one of two possible displays. **If no ROTL Access number** has previously been entered, the 930A will prompt the user to enter one as shown below:



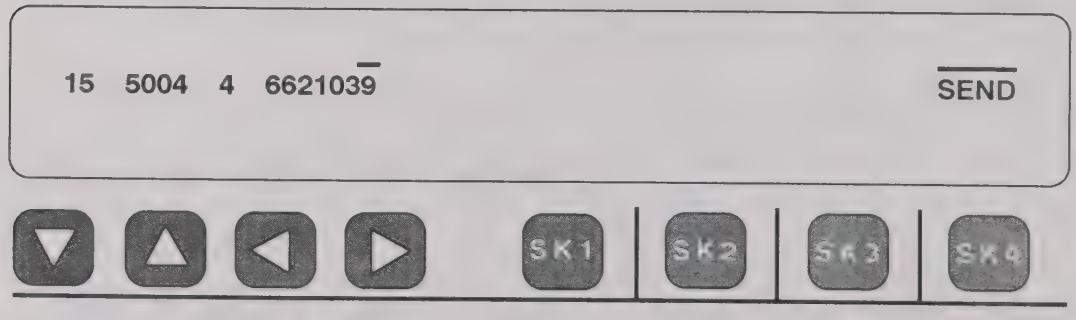
The number may be **DTMF**, **MF** or **DP**. You select the correct form by pressing Softkey 4 until the type you want is displayed. Then enter the **ROTL Access Number**. If a number had already been entered, it would have been displayed instead, as shown below:



This could just as well have been a **DP** or an **MF** sequence. The above is for example purposes only. If another number is desired, press the **CLR** key and enter the new number.

If the 930A is connected directly to the **ROTL access port** of a switch, **no** number is required. Press the **CLR** key to remove any existing numbers and then go **OFF HOOK**. **If the 930A is connected to a dial-up line**, or at the **DSX**, place the front panel hook switch in the **OFF HOOK** position to send the call sequence.

In either case, you will see a Call Progress indication on the display (Busy Signal, etc.) as well as an audible indication. The 930A automatically advances to the **ROTL priming** screen when you go **OFF HOOK**. **You must wait** until the audible indication of call completion before sending the **ROTL** priming digits. A typical **ROTL** priming screen is shown below:



The flashing cursor over **SEND** prompts you to press Softkey 4 to outpulse

4-13 USING THE 930A AS AN E911 PSAP SIMULATOR (OPTION 930A-37)

The 930A can be optioned to test the ability of a digital switch to complete Enhanced 911 calls, automatically retry unanswered 911 calls, and transfer 911 calls to the appropriate **P**ublic **S**afety **A**nswering **P**oint (PSAP) on demand.

This option requires that Option 930A-09E be installed as well. Detailed information describing the use and operation of the E911 option is provided in Application Note 3: E911 PSAP Simulator Software.

When installed in the 930A, the E911 option can be found in Menu Option 52: E911 EMULATION.

Refer to Application Note 3, provided in the front pocket of this manual, for details on the operation of this option.

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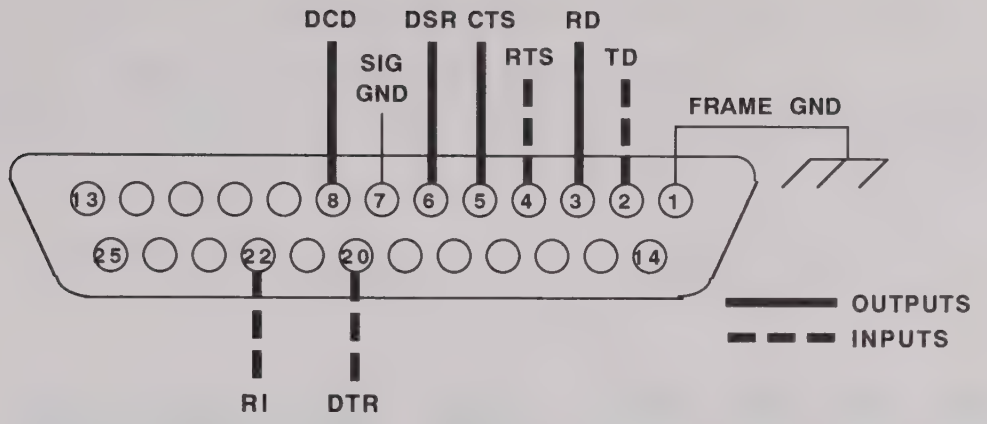


PIN	TO DTE	TO DCE	NAME	FUNCTION
1			FG	FRAME GROUND
2		→	TD	TRANSMITTED DATA
3	←		RD	RECEIVED DATA
4		→	RTS	REQUEST TO SEND
5	←		CTS	CLEAR TO SEND
6	←		DSR	DATA SET READY
7			SG	SIGNAL GROUND
8	←		DCD	DATA CARRIER DETECT
20		→	DTR	DATA TERMINAL READY
22	←		RI	RING INDICATOR

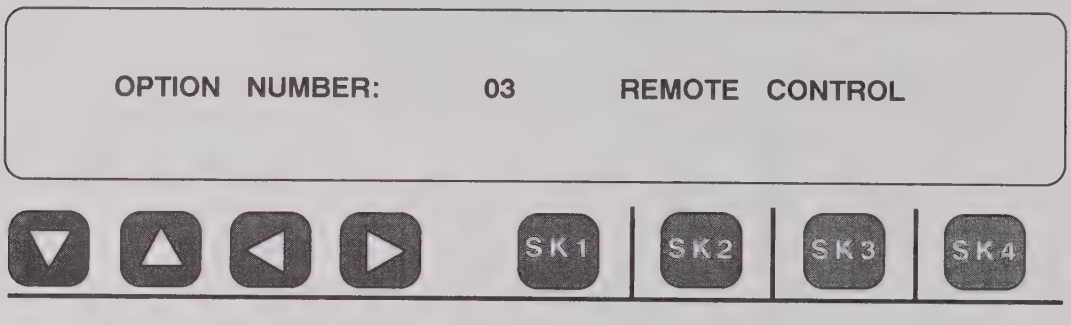
RS-232C CONNECTOR PINOUTS

FIGURE 5-2

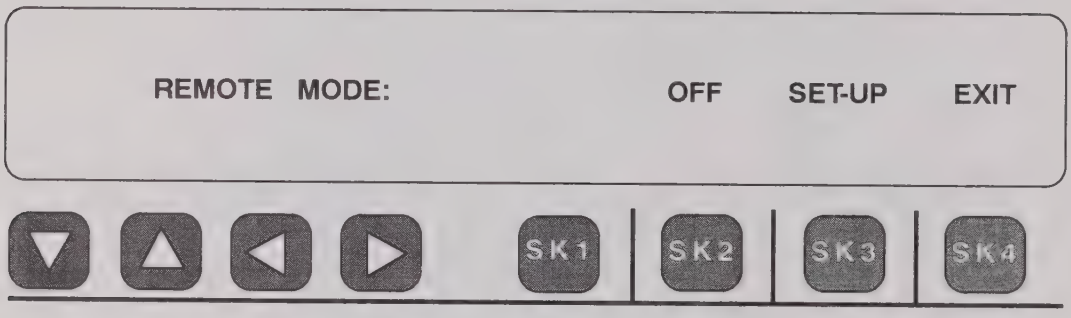
The remaining 15 pins are not connected. **Applying a voltage to pins 1 or 7 will cause damage to the 930A.** The pinouts shown in Figure 5-2 connect directly to a **DTE** (Terminal) or printer. For connection to a **DCE**, a "NULL MODEM" connection, as previously described, must be used.

5-1.1 SELECTING THE REMOTE MODE

To select any of the remote modes, press the **OPTION MENU** key and use the **UP/DOWN** arrow keys to go to Option Menu 3. The display will appear as:



Press any softkey under the display to enter the option:



If a Remote mode has already been selected, the current mode will be displayed instead of the word **"OFF"**. Pressing Softkey 2 (under **OFF**) pages through the Remote Modes. The modes available with Option 930A-10C RS-232C Remote are:

"OFF" ----------	Manual control
"TERMINAL" -----	For use with dumb terminals
"COMPUTER" -----	For use under computer control
"PRINTER" -------	Used to drive any serial printer connected to the RS-232 serial port.

Other modes displayed are custom remote modes for a particular customer. Selecting one of these modes will have no effect if they have not been installed in the unit. Press Softkey 2 until the desired mode appears. Press Softkey 4 (under **EXIT**) and the current mode will be initialized.

5-4.6.2 USING THE HELP MENUS

Pressing the **HELP** key on the 930A brings up a series of menus for the user. The menu presented will depend on the function the 930A is executing. Transmitting the ASCII **"?"** character remotely has the same effect as pressing the **HELP** key.

Many of the 930A's features are controlled using softkeys (the four unlabeled keys directly beneath the display).

These softkeys often take the place of thumbwheels or on/off toggles. The current setting is usually displayed above the softkey (for example, in **MEASURE NOISE**, the display over Softkey 2 shows either **"C-NOTCH", "C-MSG", "3K FLAT", or "S/N"**). If the display shows what you want, you do nothing: the setting is already correct. Otherwise, press the softkey until the display shows the setting you want.

This is fairly simple for you or I, but for a computer it presents problems. Just "looking" to see that the display shows the desired setting is a nuisance. Going into a loop that presses the softkey, looks at the display, and repeats until it's correct is a major annoyance.

Using the **HELP** menus allows the computer to avoid this procedure. When it wants the C-Notch filter, the computer sends a short character string that always selects C-Notch, regardless of the previous state.

Once you have used a **HELP** menu to put the 930A in a known state, it may be more efficient to use the softkeys in the usual way. You would always use the **HELP** menus when your program begins: this provides a simple and foolproof initialization. After using a **HELP** menu once to put the 930A in a known state, you may continue to use the **HELP** menus throughout your program or pursue greater efficiency by using the softkeys. The difference is typically only a few extra characters and a few hundred milliseconds, and the choice is really a matter of programming style.

The following section gives a brief overview of the **HELP** menus and includes some sample command strings.

TRUNK TYPE (Analog circuits)

Trunk Type Help Type/Sense Direction Bridge/Term Ohms 2W/4W

Trunk Type	A =Trunk Type			
Help	? =Help			
Type	J =Loop	K = Ground-Start	L{1-5}J = E&M Type I-5	
Sense*	K = Normal	; = Reverse		
Direction	K =Battery	; = Contact	K =SEND-E	; = SEND-M
Bridge/Term	K =Bridge	; = Terminate		
Ohms	J =150Ω	K = 600Ω	L = 900Ω	; = 1200Ω
2W/4W	K =2 Wire	; = 4 Wire		

* (Loop and Gnd-Start only)

Examples:

E&M Type I	TERM	SEND-E	4W 600	**"A?L1JK;K;"**
E&M Type II	TERM	SEND-M	2W 900	**"A?L2J;;LK"**
LOOP NORMAL	TERM	CONTACT	2W 900	**"A?JK;;LK"**

Toggle Bridge/Term	**"K"**
Toggle Direction	**"L"**

MEASURE NOISE

Measure Noise Help Filter Mode* Reference

Measure Noise	F = Measure Noise
Help	? = Help
Filter	J = 3 KHz flat K = C-Message L = C-Notch ; = Signal/Noise
Mode* †	K = Balanced ; = Noise-to-ground
Reference †	K = Absolute (dBrn) L = Set 0 (dB relative to current level) ;nnndJ = dBrn0 (dB relative to nnn dBrn)

* Not available in PCM. In PCM, the 930A measures channel noise only.

† Not available when making signal/noise measurement.

Examples:

Measure balanced noise in dBrnC using the C-Notch filter: **"F?LKK"**

Measure signal/noise: **"F?;"**

Measure noise-to-ground relative to 90 dBrn using the 3 KHz flat filter:
"F?J;090dJ"

Measure noise: **"F" "Z"** (Wait 1 sec. between sending "F" and "Z")
or **"FZZ"** (Disregard first measurement)

Note: If a tone has been selected in **SEND TONE**, and the output is **ON**, the tone will also be sent in **MEASURE NOISE**. To measure far-to-near noise on a 2-wire circuit, be sure **SEND TONE**'s output is set to **"OFF"**.

5-4.6.3 WHEN DOES THE 930A SEND A BELL?

The 930A can be set to wait for or detect a variety of events. The 930A sends the bell character to let the remote operator or computer program know that such an event has occured. Some events are reported only if the user selects them. Others are reported only if the 930A is performing a certain function. You can select the events which will be reported from Menu Option 34: SELECT REPORTS. This allows reporting to be turned ON or OFF for PCM Errors, Received Calls, or Wink Timing. The bell is sent **only** in Computer Remote mode. The following lists the events and conditions for a bell to be sent.

EVENT	REPORTED WHEN 930A IN:
PCM ERROR--An error on the T1 span such as a slip, bipolar violation, remote alarm, etc. has been detected.	**PCM** Trunk Type. **REPORT PCM ERRORS** selected.
INCOMING CALL COMPLETE--The 930A has received a call.	Option Menu 4: Digit Receiver **REPORT RECEIVED RECORDS** selected.
WINK TIMING AVAILABLE--A call has completed or abandoned, and a wink, off-hook, delay dial event, dial-tone or credit card "bong" was expected.	Option Menu 2: Send Digit Sequences Option Menu 4: Digit Receiver **REPORT WINK TIMING** selected.
WINK FAILURE--An expected wink, off-hook, delay dial event, dialtone or "bong" failed to appear or was not recognizable.	Option Menu 2: Send Digit Sequences Option Menu 4: Digit Receiver
SIGNALING BIT CHANGE--An A, B, C, or D bit has changed state on one of the 24 PCM Channels.	**PCM** Trunk Type Option Menu 20: 24 Bit Display
RINGING OR LINE SEIZURE--The 930A detects ringing or seizure and goes off-hook.	Option Menu 32: Dial-Up Testline Option Menu 33: Dial-Up Sweep

EVENT	REPORTED WHEN 930A IN:
IMPULSE or HIT--An Impulse, gain hit, phase hit or dropout has occured.	Option Menu 11: Impulse and Hits
CALL PROGRESS FAILURE--The 930A detects Busy, Reorder, Dead Line or any other call progress failure when it attempts to access a test line.	Calling to a test line from: Option Menu 2: Send Digit Sequences Option Menu 26: ROTL/Responder Option Menu 27: ROTL Interrogator Option Menu 28: Transponder Test Option Menu 29: Call 102 Line
TEST DATA AVAILABLE--A test to a far end test line has completed, or has a screen full of results available. LOSS has one screen of data (one bell), GAIN SLOPE has three screens of data (one bell each), etc.	Calling to a test line from: Option Menu 2: Send Digit Sequences Option Menu 26: ROTL/Responder Option Menu 27: ROTL Interrogator Option Menu 28: Transponder Test Option Menu 29: Call 102 Line

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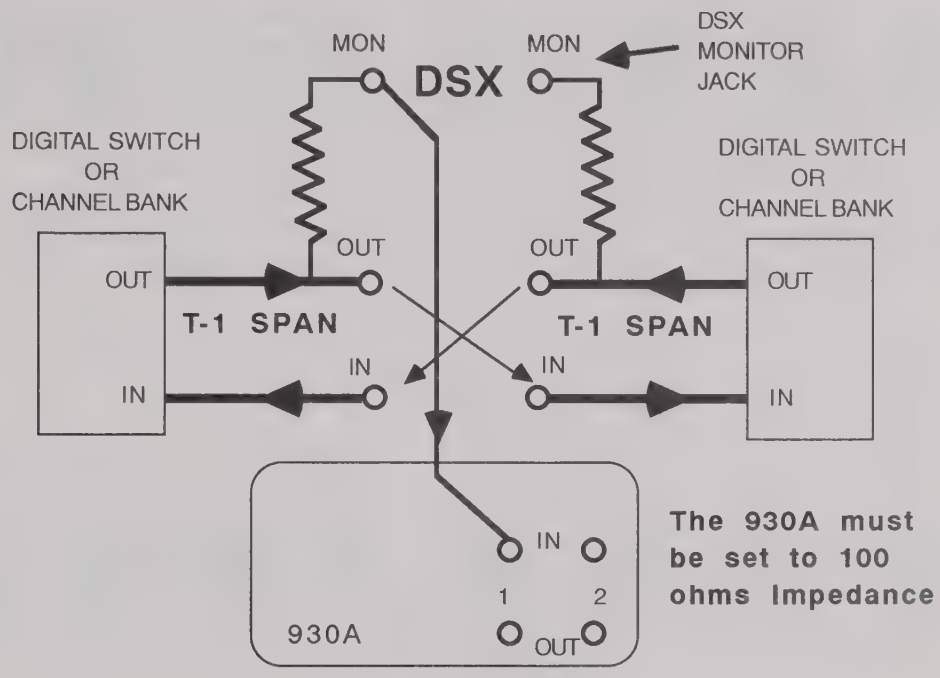
6-2 HOW TO MONITOR A T-1 SPAN

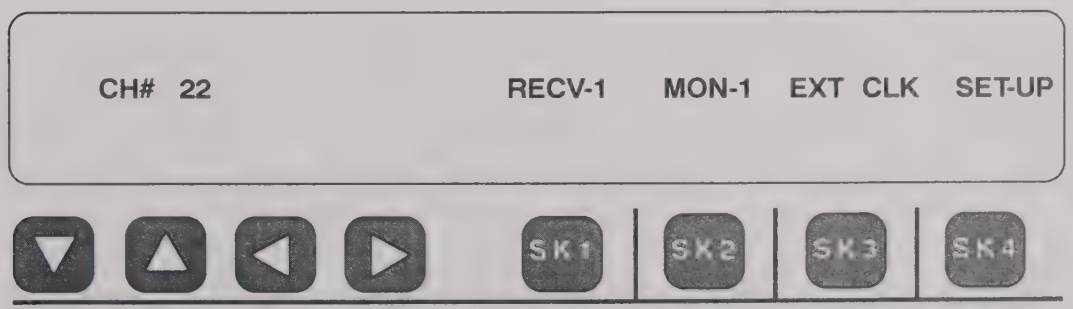
The most basic T-1 test you can make is to monitor the span in one direction. The test cord connection to the **DSX Monitor jack** is shown in Figure 6-2 below:



PCM MODE: MON-1

MONITORING ONE DIRECTION ON A T-1
FIGURE 6-2

All you have to do is connect the 930A's receiver (**PCM IN 1**) to the **DSX Monitor jack** with a test cord and place the 930A in the **MON-1** mode. The 930A display will look like the one below when it is set correctly.

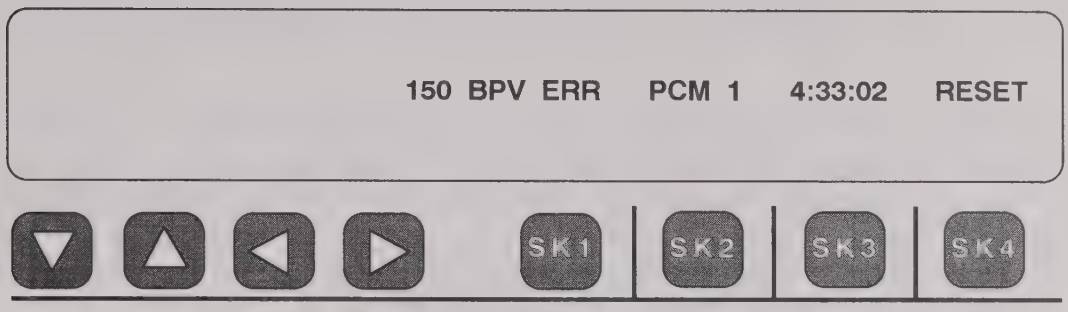


A good question to ask here would be, "What can I test with this?" Well, **you can measure** anything, such as levels and frequencies or noise. You can't do anything active like placing a call or sending a tone or measuring return loss. **You could receive and analyze** the digits of incoming calls if you have purchased Option 930A-01. You could move the test cord to the other monitor jack and capture the digits of the outgoing calls. **You could measure** the wink timing. You could listen to the traffic on the speaker. **You could see** the status of the A and B bits on all 24 channels. **You could count** BPVs, frame slips, frame errors, frame losses and CRC errors (ESF). **You could measure the T-1 voltage** at the DSX Monitor level.

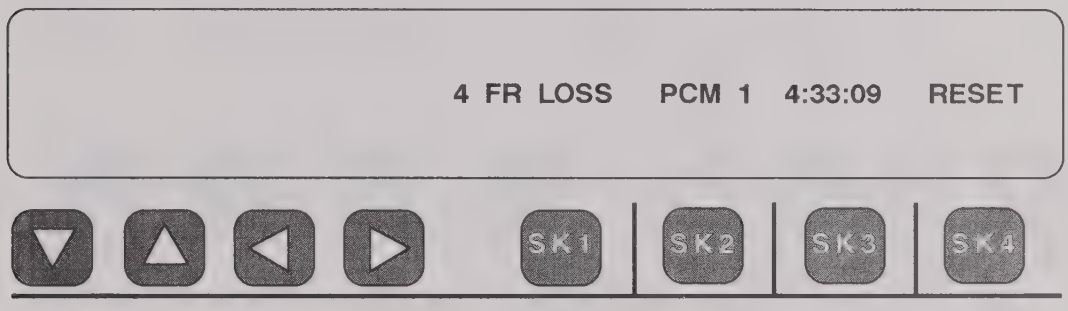
Besides **MEASURE TONE** and **MEASURE NOISE**, you will find that the following menus, under the **OPTION MENU** key, are also useful.

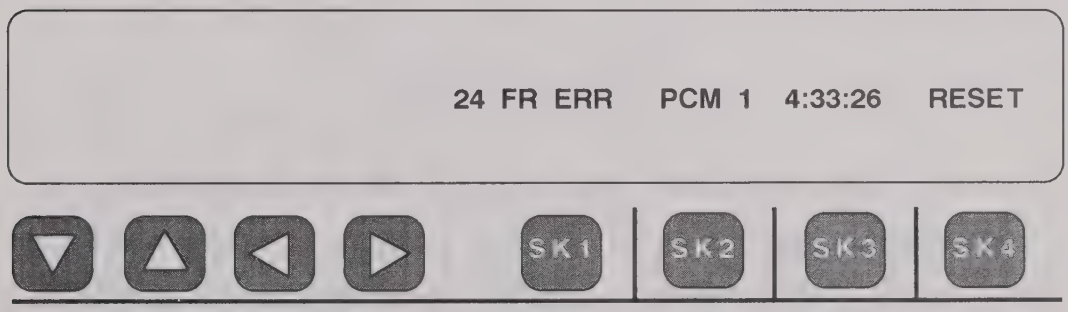
Option Number: 4	DIGIT RECEIVER	Option 930A-01
Option Number: 8	SUPERVISION MONITOR	Standard
Option Number: 9	WINK TIMING	Standard
Option Number: 20	24 BIT DISPLAY	Option 930A-08E/09E
Option Number: 21	TOGGLE A/B BITS	Option 930A-08E/09E
Option Number: 40	SEND PCM ALARMS	Option 930A-08E/09E
Option Number: 41	READ T1 VOLTAGE	Option 930A-08E/09E
Option Number: 42	T1 WANDER	Option 930A-08E/09E
Option Number: 43	T1 ERROR COUNTERS	Option 930A-08E/09E
Option Number: 44	T1 ERROR HISTORY	Option 930A-08E/09E

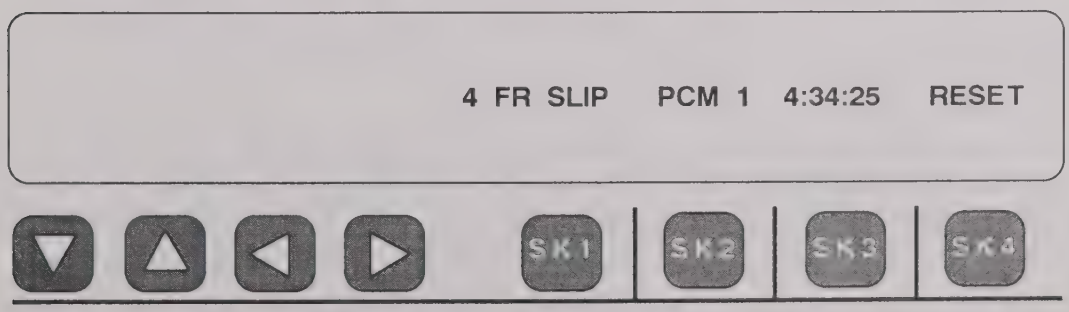
You will quickly discover that monitoring only one side at a time has its limitations. This is why the 930A has **Option 930A-09E** available. This gives you two receivers (**PCM IN 1** and **PCM IN 2**). Two receivers let you point the finger in the right direction when you have a trouble report.



By pressing Softkey 1, or the **UP/DOWN** Arrow keys, you can page through the other counters to show you the Frame Losses, Frame Errors (or CRC Errors in ESF) and Frame Slips. Some example displays are:



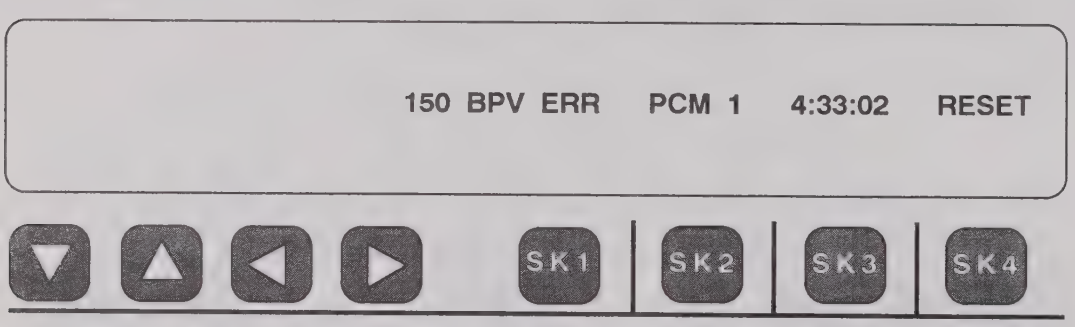




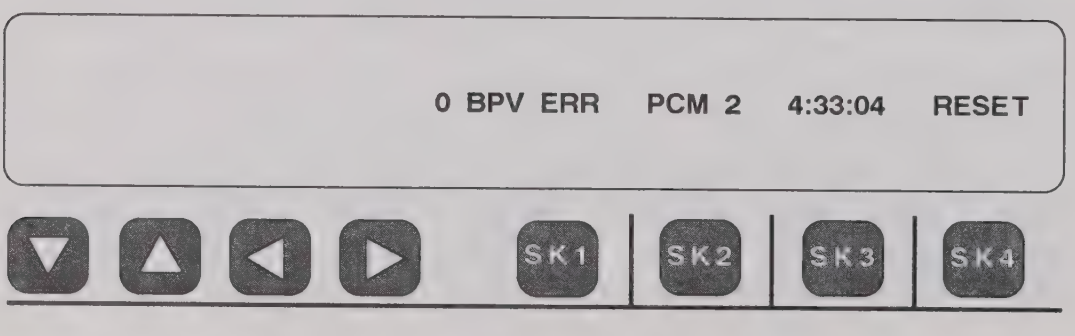
As you can see in this example, side 1 does not look too good. But what about side 2?

Since you are in the **MON-1&2** mode, you can easily check what is on side 2 by pressing Softkey 2 to toggle back and forth from side 1 to side 2. The 930A has independent counters on each side so you can see where the problems come from. This is like having two error counting test sets connected to the T-1 span. For this example, suppose you wanted to compare the Bipolar Violation counts on side 1 to those on side 2.

Let's say that side 1's counter is:



Now, press Softkey 2 and the display shows side 2 as:

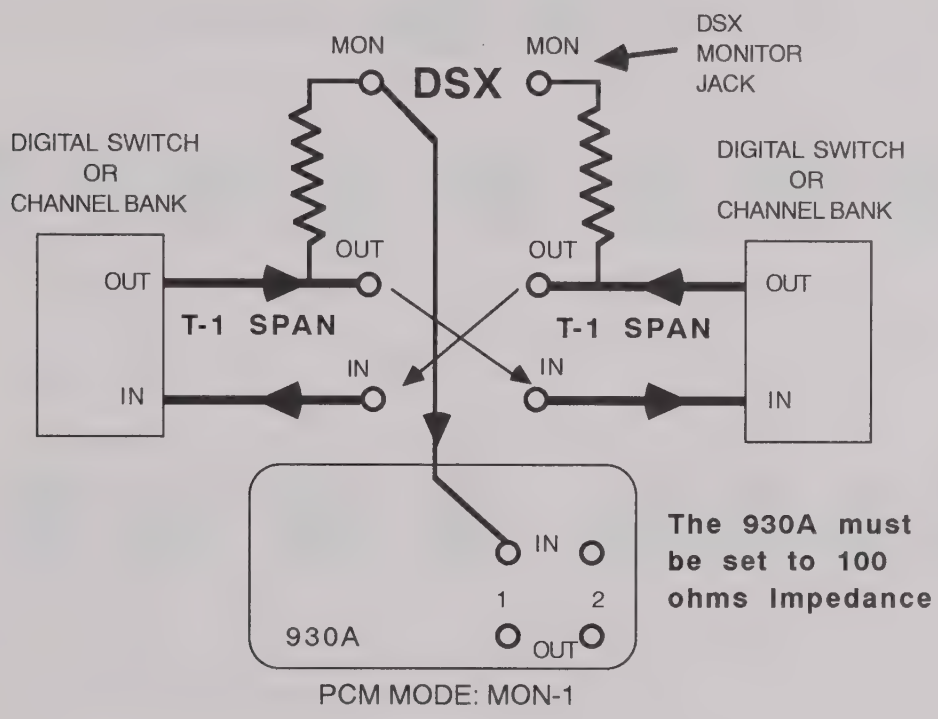


The conclusion is obvious. We need to do some serious testing toward side 1 because the problem is coming from that direction.

The parameters measured by the 930A in Menu Option 43 are: BPV Errors, BPV Rate, Frame Errors, Bit Slips, Frame Slips, Frame Losses, No PCM, Error Free Seconds, %EFS, Errored Seconds, %ES, Severely Errored Seconds, %SES, Failed Seconds, %Failed, Available Seconds, %Available, Unavailable Seconds and %Unavailable Seconds. All measurements are in accordance with CCITT G.821.

6-7 HOW TO MEASURE THE T-1 VOLTAGE AT THE DSX JACKS (MENU OPTION 41)

To measure the positive and negative base-to-peak voltages, connect one, or both, of the **PCM** receivers to the **DSX**. For example, take the case of a 930A in the **MON-1** mode connected to the monitor jack on a **DSX**.



MEASURING T-1 VOLTAGE AT THE DSX MONITOR JACK
FIGURE 6-9

You should know what voltages are expected at this point to make sense out of the readings. For instance, if you plugged into the **DSX** output jacks, you would expect to see about ±3.0 Volts base-to-peak. At the monitor jacks, however, you should expect to see about one tenth the voltage, or roughly ±0.3 volts base-to-peak. You should not read less than ±0.2 volts base-to-peak at the DSX Monitor jack. If you do, this indicates a possible problem on the span. It could be a problem with a repeater, a defective cable, poor equalization, or too long a cable run from the equipment to the DSX.

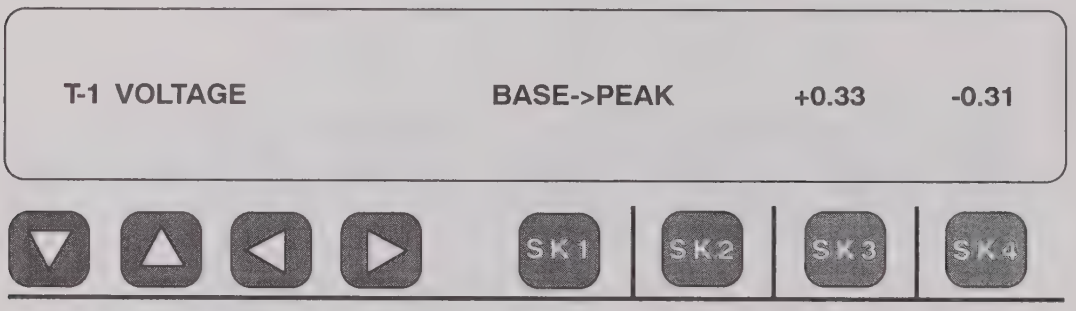
You measure the voltage on the 930A from Menu Option Number 41: **READ T-1 VOLTAGE** after you have set the PCM Trunk Type and connected the test cords to the DSX.

Press the OPTION MENU Option Menu function key.

Use the UP/DOWN arrow keys to

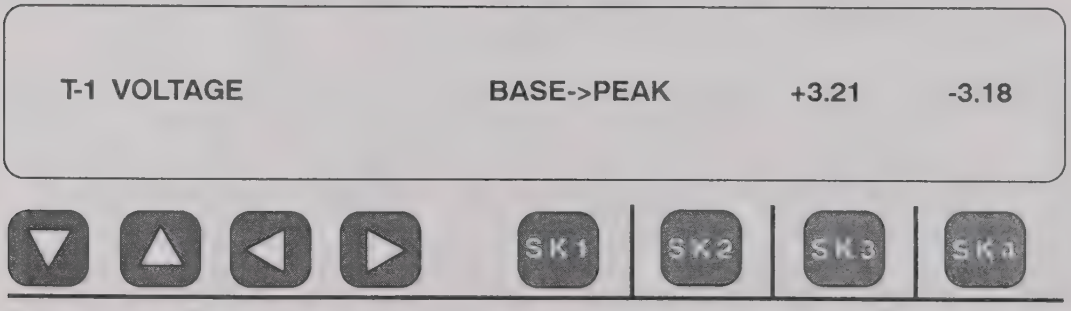
get to **Menu Option 41: READ T-1 VOLTAGE**.

Press any softkey to get into the main menu and the 930A will display its readings as Base-to-Peak voltage. An example of a typical reading at the **DSX Monitor** jack is shown below.



This is about what you would expect, give or take a tenth of a volt. You would expect problems if these readings were below ±0.2 Volt. That might indicate that you had cable runs in excess of the **DSX** limitations. Then you might have to put your signal through a bridging repeater first.

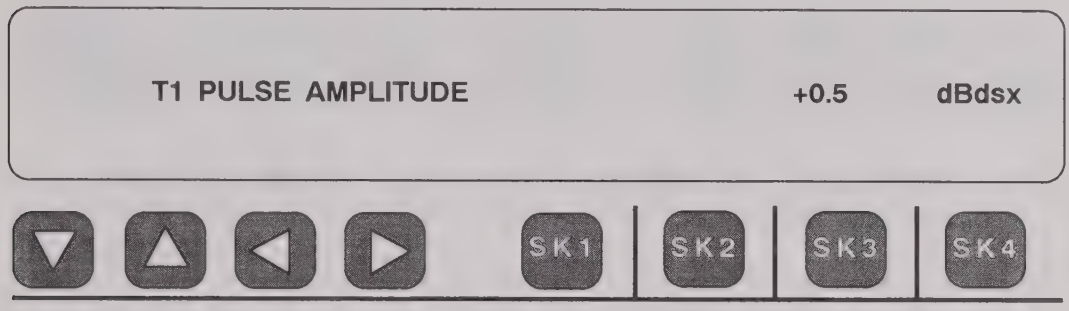
If you were to measure the voltage **directly at the DSX output**, then you would see a display that would look more like the one below.



You can see from this that the positive and negative going peaks are close to each other in terms of absolute value. If they were very different from each

other (more than 0.5 Volt), or if they were much higher or lower than the nominal 3 Volts (say ±6.0 Volts), you would expect to have problems.

To read the T-1 pulse amplitude in dBdsx instead of voltage, press any softkey under the display and the display will become:



3.0 Volts base-to-peak is equal to 0.0 dBdsx. Readings between 0 and 1 dBdsx would be expected at the DSX output jacks. Readings of about -20 dBdsx would be expected at the DSX Monitor jacks.

6-8 TO CHECK A/B/C/D BIT STATES ON ALL 24 CHANNELS (MENU OPTION 20)

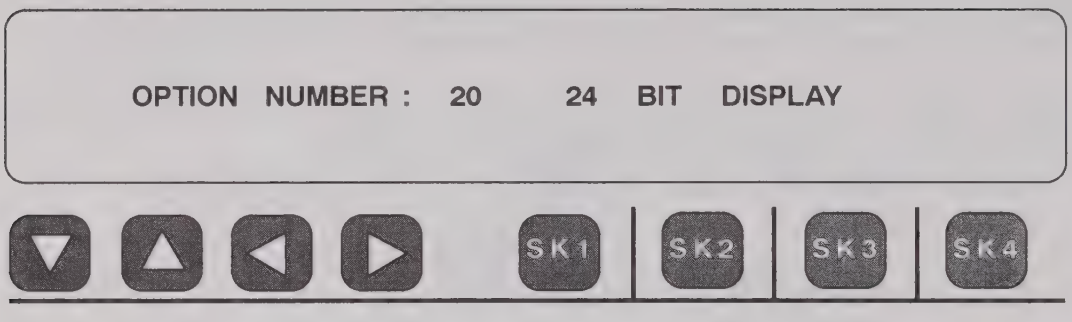
When you are working on a T-1 span, it is sometimes very useful to be able to see the state of the A and B bits (also C and D bits on ESF) on all 24 channels simultaneously. With the 930A, you can see these bits at the DSX monitor jacks, and you can check them in one direction (Option 930A-08E), or in both directions (Option 930A-09E).

To look at the supervision states, all you have to do is connect your 930A to the DSX as shown in Figures 6-2 or 6-3. Make sure the 930A is set to the PCM Trunk Type and that default settings are correct. If it is set to the **MON-1** mode, you will be able to look at the supervision bits on one side at a time. If you are in the **MON-1&2** mode, you can switch from **RECV-1** to **RECV-2**, and look at the supervision bits in both directions. When the 930A is set-up, do the following:

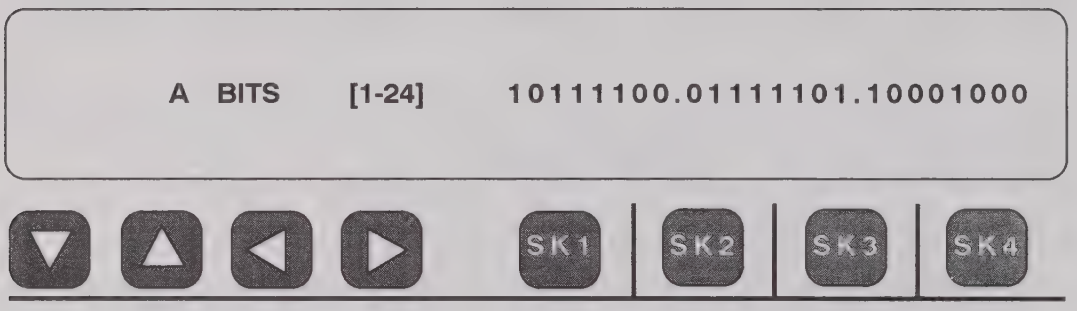
Press the OPTION MENU **Option Menu** function key.

Use the UP/DOWN arrow keys to

get to **Menu Option 20: 24 BIT DISPLAY**.

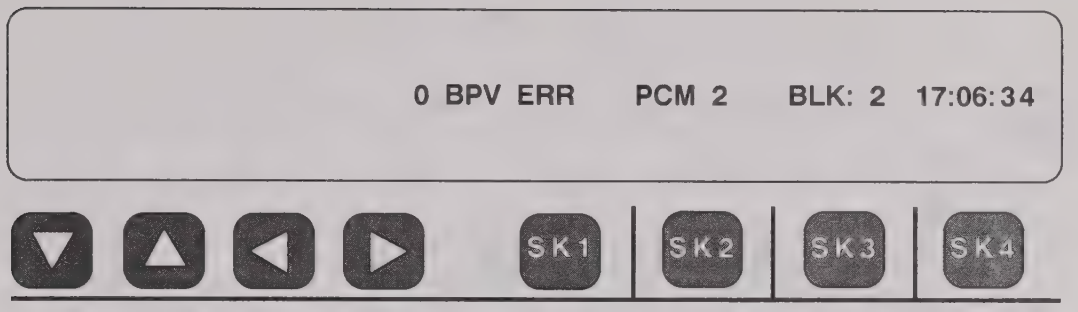


Press any softkey under the display and the A bit display will come up. An example appears below:



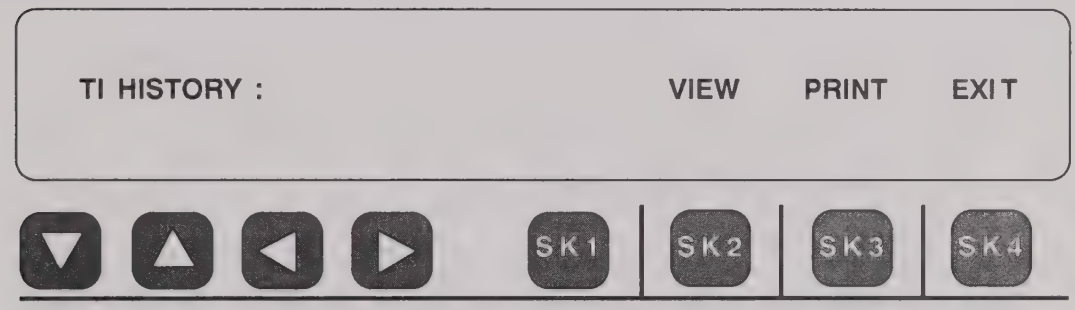
The channels are numbered from 1 to 24, left to right. The bits have two states, 0 and 1. Usually a 0 indicates On Hook and a 1 indicates Off Hook or busy. On a working span, you will see calls completing and terminating, so the display will be changing constantly as calls come and go. Pressing any softkey or arrow key will page you through the B bit display. On an Extended Superframe span, you will also get the C and D bit displays. **Remember**, for the time being, **ESF** gangs the A and C bits, and B and D bits, together. Looking at the A and B bits will be enough.

If you are in **PRINTER** Remote mode, the 930A will print a copy of it's display whenever a bit changes. In **COMPUTER** remote, it will send a Bell (ASCII 07) to the computer.

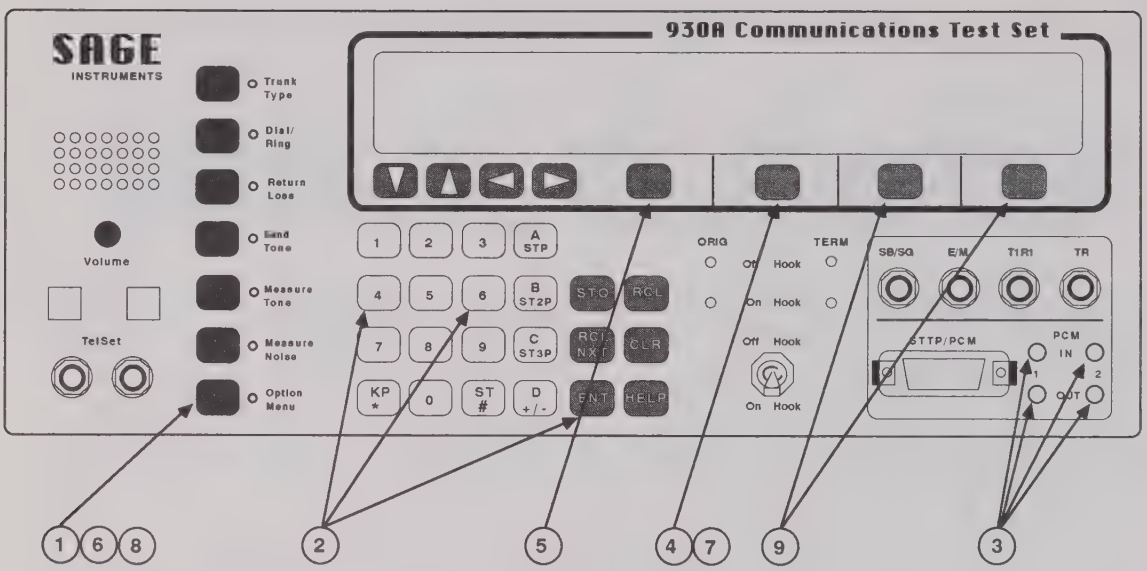


In this example, we see that there were no errors coming into side 2 in that time frame. This points the finger toward whatever is connected to side 1 as the source of the problem.

To return to the main menu, press the **OPTION MENU** key and the display will become:



To print out the results to date, press Softkey 3 under **PRINT** and the results of the testing for both sides will be printed out starting at Block 1 if you have connected a printer to the 930A. If the 930A is already in Printer remote (see Section V) and a printer has been connected during the test, the results will be printed out automatically as Blocks are incremented (every 15 minutes) without having to press Softkey 3.



To select and use **DS-1 Bit Error Rate Testing (BERT)**:

1. Press the **OPTION MENU** function key.
2. Enter the number **46** on the numeric keypad and press the **ENT** (Enter) key.
3. Connect Test Cords for either single or dual-direction **BERT** as shown in Figures 6-15 and 6-16.
4. Press Softkey 2 under **TEST** to begin testing with the default settings, or skip this step to change defaults.

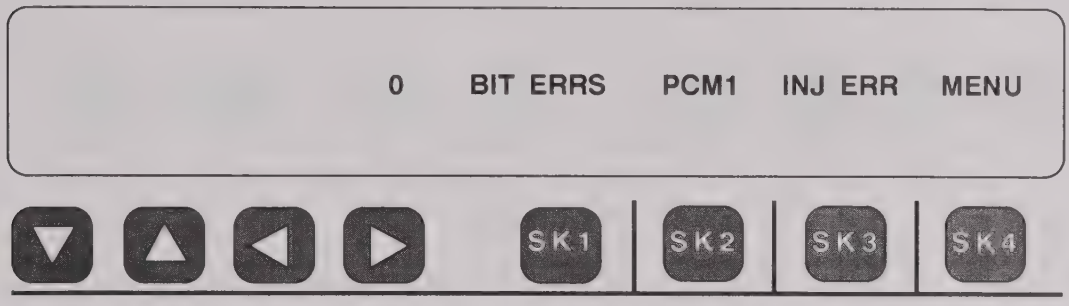
To check or change the default settings or patterns:

5. Press Softkey 1 under **SET-UP** in the main **SELECT** menu and use the softkeys to select and change default settings as required.
6. Press the **OPTION MENU** key to get back to the main menu.
7. Press Softkey 2 under **TEST** to begin testing.
8. Press the **OPTION MENU** key to return to the main menu.
9. Press Softkey 3 under **HISTORY** to review previous 24 hours test results, or press Softkey 4 under **EXIT** to stop testing.

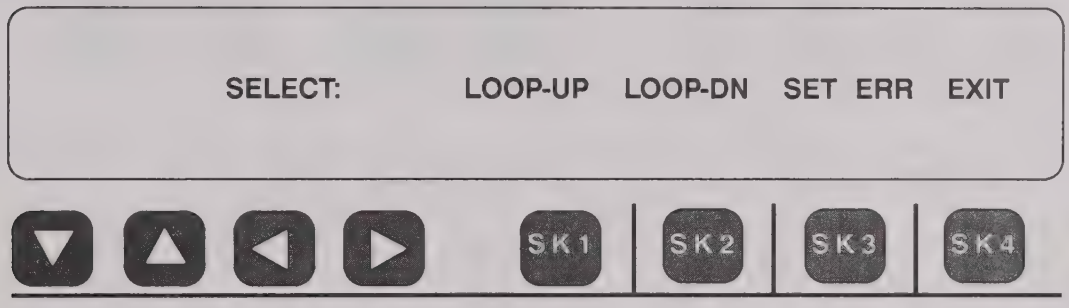
DS-1 (T-1) BIT ERROR RATE TESTING
FIGURE 6-14

6-17.6 HOW TO SEND ERRORS AND SELECT OTHER TYPES

The factory default injects single bit (or logic) errors when the softkey under **INJ ERR** on the main BERT display is pressed.

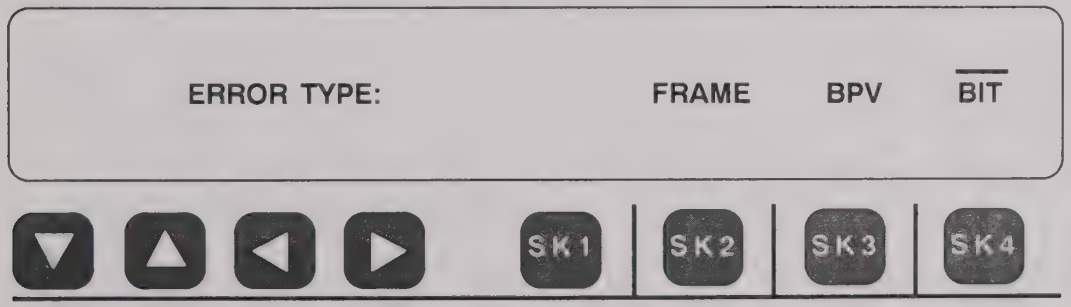


To change the type of errors being injected, press Softkey 4 under **MENU** to bring up the main **SELECT** display.

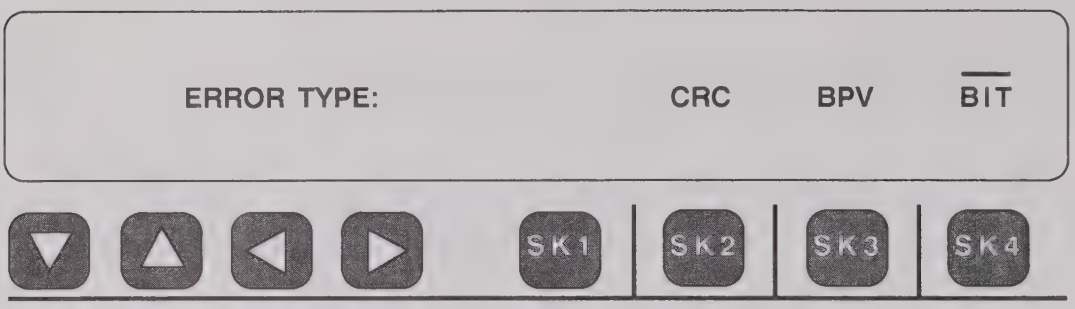


Press Softkey 3 under **SET ERR** to bring up the **ERROR TYPE** display. There are three possible displays depending upon whether you have chosen D4/Superframe, ESF or Unframed operation.

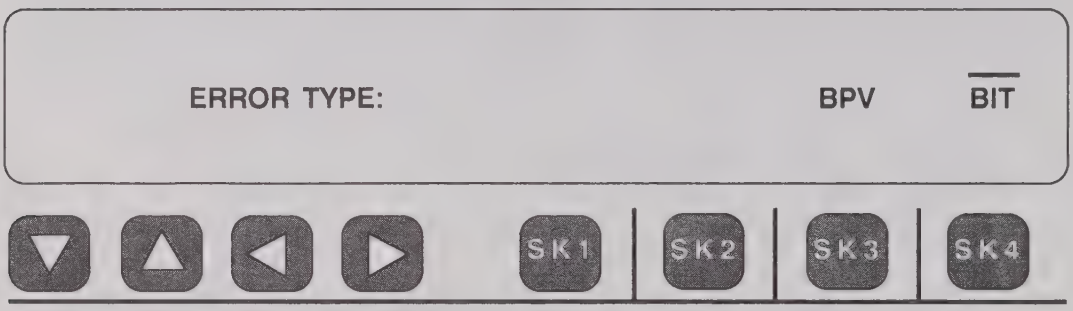
D4/SUPERFRAME



ESF



UNFRAMED



You press the softkey directly beneath the type of error you want to send and the 930A display returns you to the main BERT menu.

When you press Softkey 3 under **INJ ERR**, the 930A will send the type of error you selected.

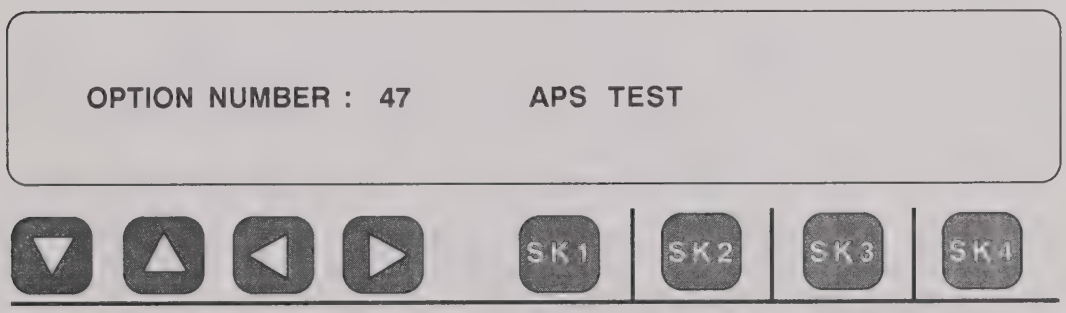
6-17.7 TESTING A T-1 AUTOMATIC PROTECTION SWITCH (APS)

The 930A has a built-in APS test located in Menu Option 47: APS TEST. This is included as part of purchased option 930A-08E or -09E. This function is used to test a T-1 Automatic Protection Switch's ability to sense an error rate in excess of its threshold and switch to the standby T-1 span. The test consists of sending a BPV rate slightly below the switch's error threshold for 20 seconds to check for false triggering, then sending a BPV rate slightly above the threshold for 20 seconds to make sure that the protection switching is activated, then sending a BPV rate of one tenth the initial rate to make sure the switch restores the span to normal operation.

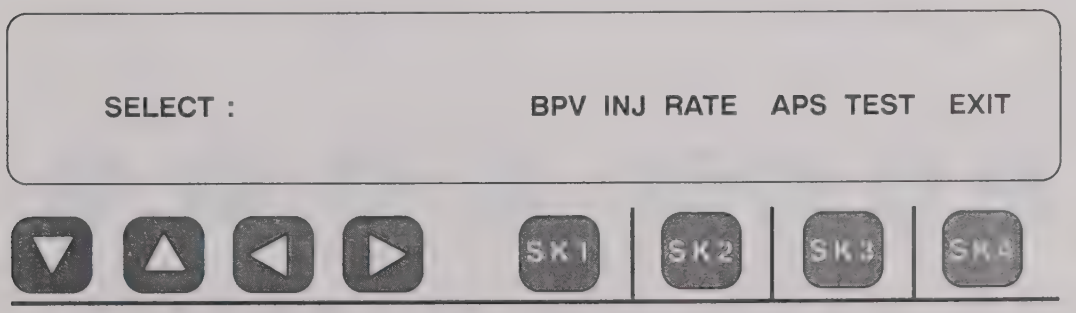
To use this feature, perform the following steps:

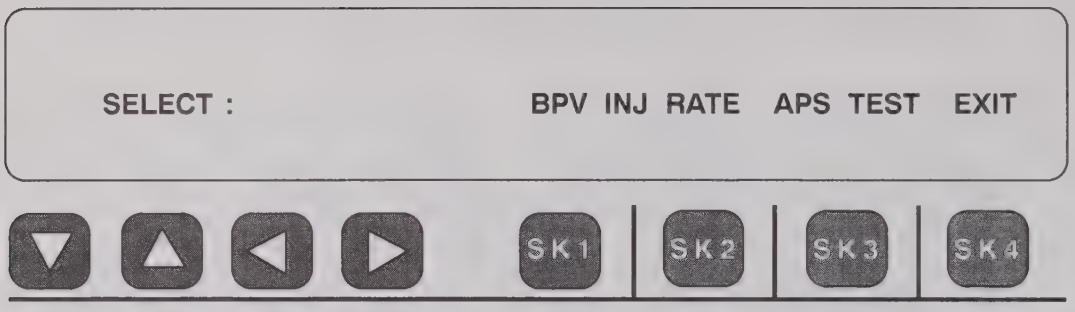
Press the OPTION MENU Option Menu function key.

Use the UP/DOWN arrow keys to select Menu Option 47: APS TEST.

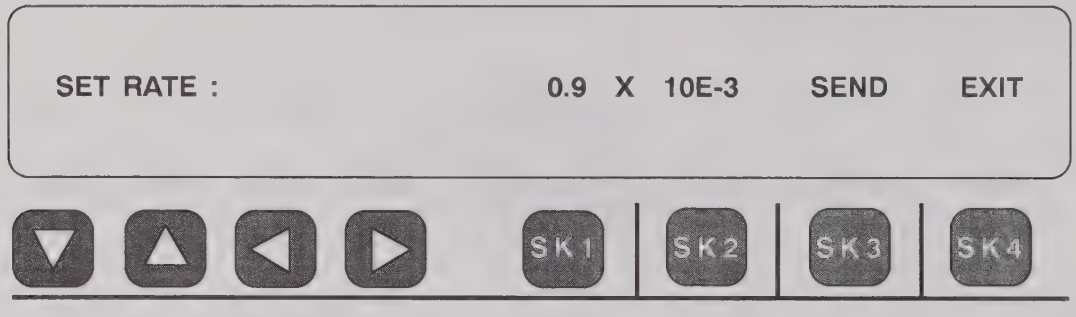


Press any softkey and you will get to the main selection menu:



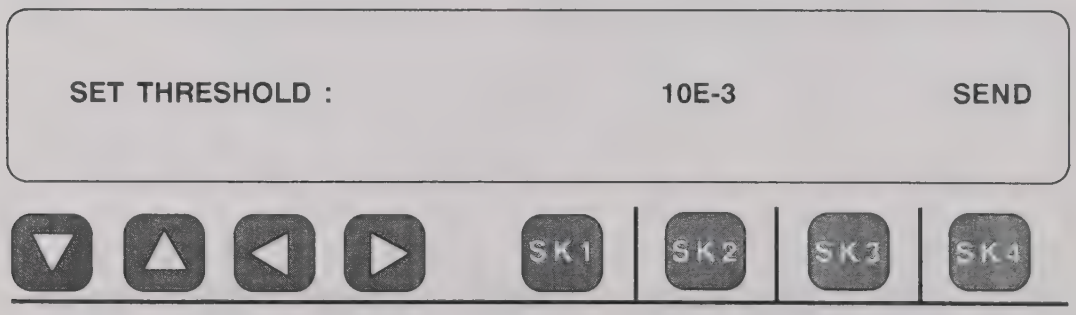


If you just want to send BPV's at a fixed rate, press Softkey 2 under BPV INJ RATE. You will get the SET RATE screen:



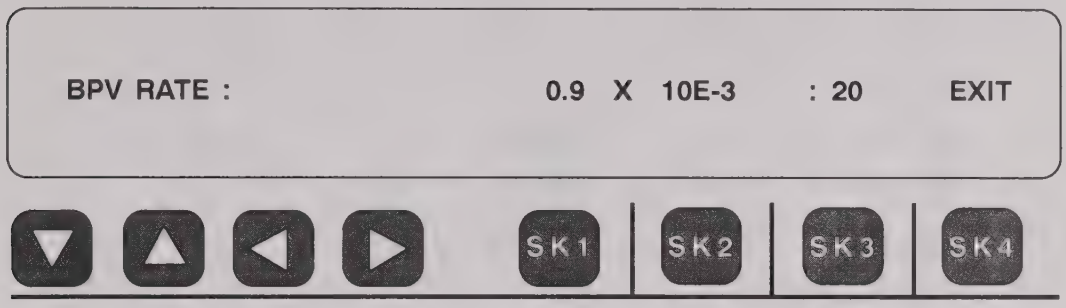
You can select a multiplier of 0.9, 1.0 or 1.1 by pressing Softkey 1 and you can select the rate exponent as 10E-3, 10E-4 or 10E-5. Once you have set the desired BPV rate, press Softkey 3 under SEND and the 930A will begin injecting errors at the selected rate.

To perform an automatic protection switch test, select APS TEST from the main menu above by pressing Softkey 3 under APS TEST. You will be asked to select the desired APS threshold:

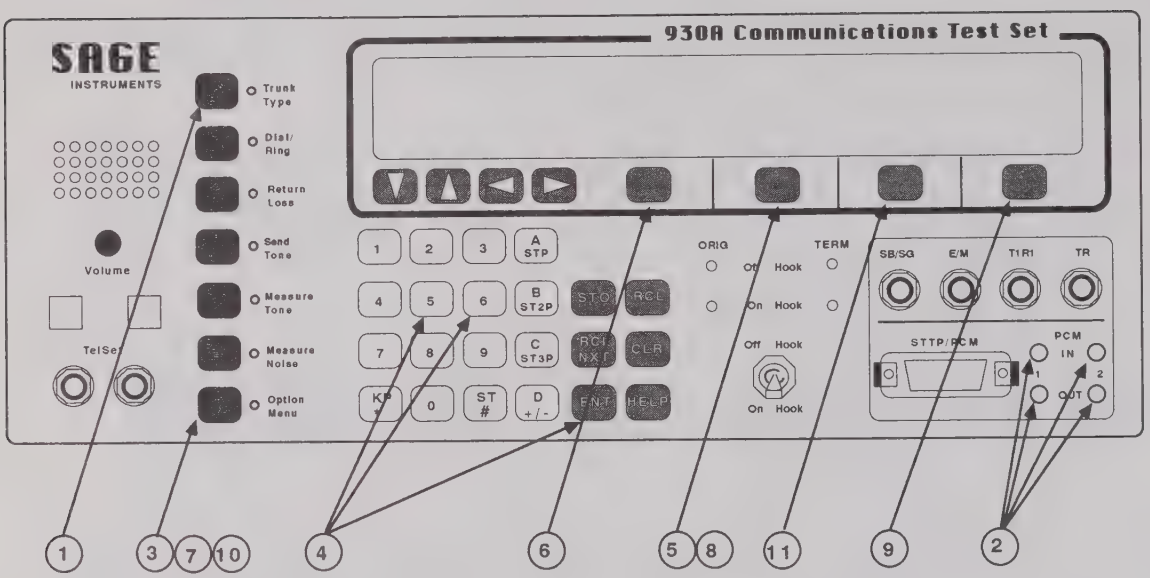


Select either 10E-3, 10E-4 or 10E-5 by pressing Softkey 2. Then press

Softkey 4 under SEND and the APS test will begin automatically. The 930A will send BPV's at a rate slightly below the selected threshold for 20 seconds. Then it will send at a rate slightly above the threshold for 20 seconds. Then it will send at a rate of one tenth the initial error rate to see that the switch returns to its normal state.



The display will look somewhat like the one above as the 930A runs through the APS test. The seconds are counted down from 20 on the counter above Softkey 3. You can terminate the test at any time by pressing Softkey 4 under EXIT. When the test is finished, the 930A returns you to the main menu.



To select and use **DS-0 Bit Error Rate Testing (BERT)**:

1. Set the TRUNK TYPE to PCM and select TERMINATE or D&I mode as described in Sections 6-1.1, 6-4 and 6-5.
2. Connect Test Cords for either single or dual-direction testing as shown in Figures 6-4, 6-5 and 6-6.
3. Press the **OPTION MENU** function key.
4. Enter the number **56** on the numeric keypad and press the **ENT** (Enter) key.
5. Press Softkey 2 under **TEST** to begin testing with the default settings, or skip this step to change defaults.

To check or change the default settings or patterns:

6. Press Softkey 1 under **SET-UP** in the main **SELECT** menu and use the softkeys to select and change default settings as required.
7. Press the **OPTION MENU** key to get back to the main menu.
8. Press Softkey 2 under **TEST** to begin testing.
9. Press Softkey 4 under **MENU** to select and send **LOOP UP/DOWN** codes or inject Errors.
10. Press the **OPTION MENU** key to return to the main menu.
11. Press Softkey 3 under **HISTORY** to review previous 24 hours test results, or press Softkey 4 under **EXIT** to stop testing.

DS-0 BIT ERROR RATE TESTING
FIGURE 6-17

6-18 DS-0 BIT ERROR RATE TESTING (BERT) WITH THE 930A (MENU OPTION 56)

If you have purchased Option 930A-22 for your 930A, you will find that Menu Option 56: **DS-0 BIT ERROR RATE (BER)** has been enabled. This feature enables you to test at the 56 KBps or 64 KBps rates. It does not test individual sub-rates such as 9.6 KBps. However, once you have tested the DS-0 path and found nothing wrong, the problem must be from the Office Channel Unit (OCU) or Channel Service Unit (CSU) back toward the terminal equipment. This means swapping out the suspected OCU plug-in or CSU/DSU or hauling out the Protocol Analyzer anyway so why add steps to the test. The purpose of the DS-0 BERT in the 930A is to help you quickly sectionalize the problem. If you can point the finger at the devices connected to the DS-0 path and away from the transmission facility itself then this has been accomplished.

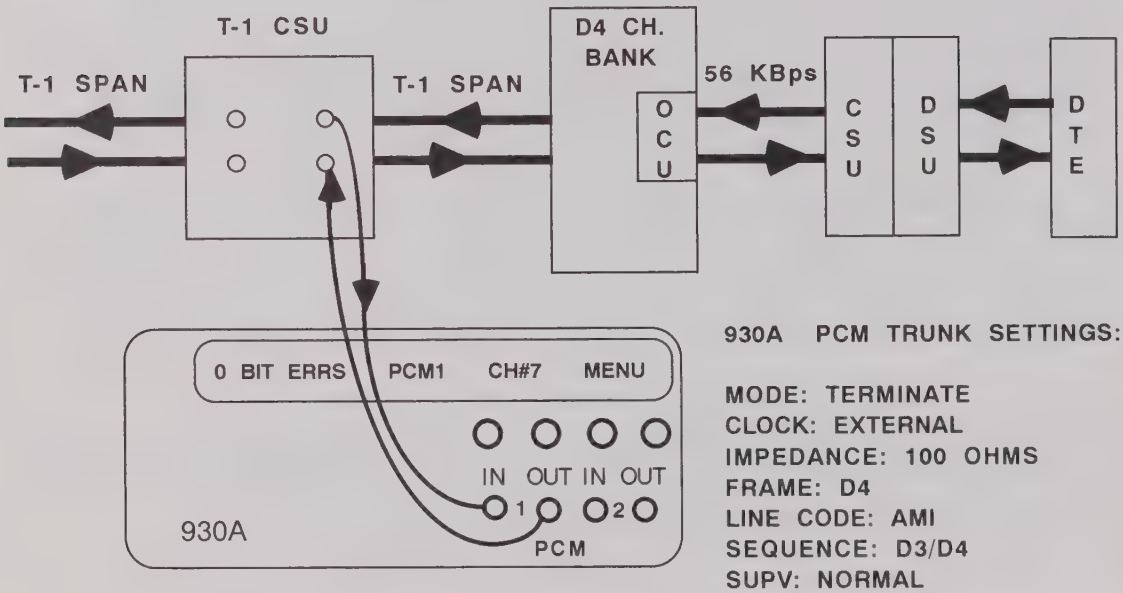
The DS-0 BERT is used with the 930A in PCM TRUNK TYPE. The Terminate mode or Drop and Insert mode can be selected. The following sections outline test cord connections, BER testing in various situations, how to send Loop Up and Down codes and how to change the test parameters if you have to.

The 930A itself can throw a loopback on a particular channel. This loopback can be for analog signals such as tones or it can be for digital patterns. This is discussed later on in this section.

6-18.1 HOW TO SET UP THE 930A FOR DS-0 BER TESTING

When you want to do a **DS-0 BER** test using the 930A, you first have to set the Trunk Type up to **PCM** and then select the correct mode (**Terminate or D&I**). Setting up the PCM Trunk Type is outlined in Section 6-1 pages 6-1 to 6-11. A brief reminder of the test cord connections and trunk settings is diagrammed below.

To Terminate a T-1 span and run a DS-0 BER Test on a channel:



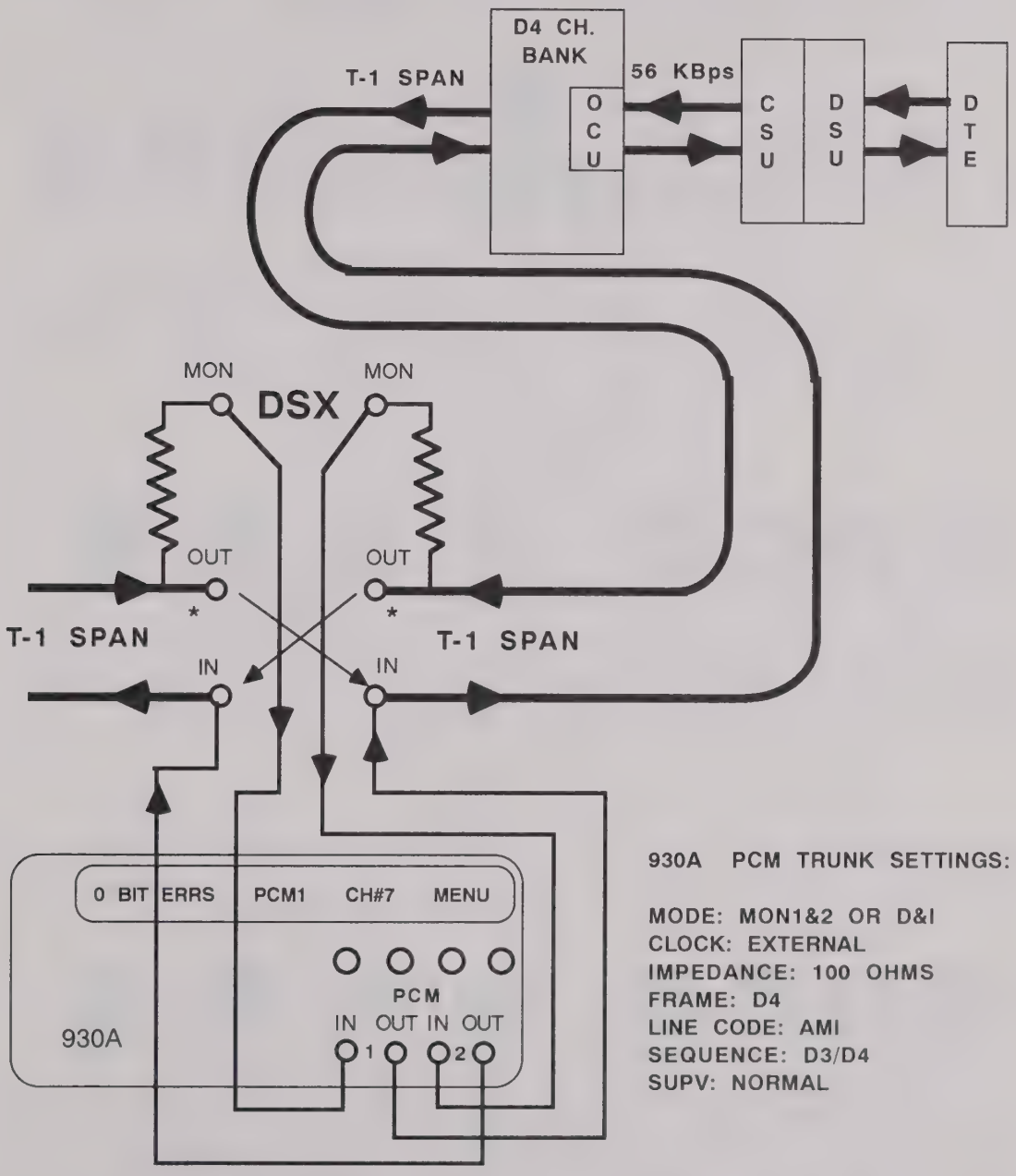
930A PCM TRUNK SETTINGS:

MODE: TERMINATE
CLOCK: EXTERNAL
IMPEDANCE: 100 OHMS
FRAME: D4
LINE CODE: AMI
SEQUENCE: D3/D4
SUPV: NORMAL

In the above example the 930A has been connected at the Equipment side of the customers T-1 Channel Service Unit (CSU). The testing is toward the D4 Channel Bank. There is an Office Channel Unit (OCU) dataport plugged into time slot 7 or channel 7 on the bank. The 56 KBps output from the OCU is fed to a combination Channel Service Unit/Data Service Unit (DSU) which interfaces to the Data Terminal Equipment (DTE). To test the path, you would successively loop back the devices on the path and run a BER test until errors were found. Start by looping the OCU, then the 56 KBps CSU, then the DSU.

A diagram of the 930A connected for Drop and Insert testing is provided on the following page.

DS-0 BER testing with the 930A in Drop and Insert mode



930A PCM TRUNK SETTINGS:

MODE: MON1&2 OR D&I
CLOCK: EXTERNAL
IMPEDANCE: 100 OHMS
FRAME: D4
LINE CODE: AMI
SEQUENCE: D3/D4
SUPV: NORMAL

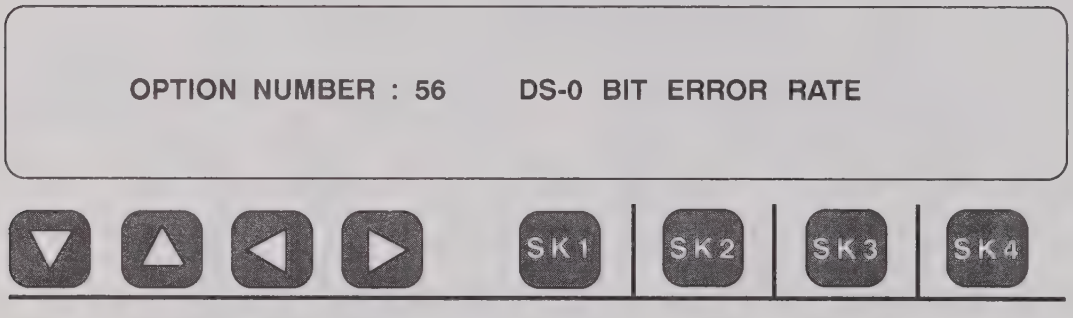
Once you have set the 930A correctly and connected the test cords, you can test in either direction on any channel you wish without disturbing the other 23 channels on the T-1 span. Details of D&I connections are contained in Section 6-3, pages 6-21 to 6-25.

After connecting the 930A to the span under test, the rest of the procedure consists of getting to the DS-0 BERT menu and running the tests. The following steps outline the set-up and test procedures.

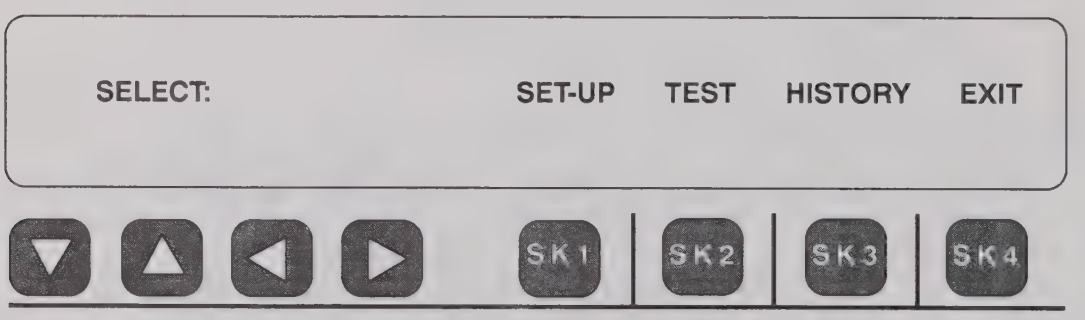
Press the OPTION MENU Option Menu function key.

Use the UP/DOWN arrow keys to

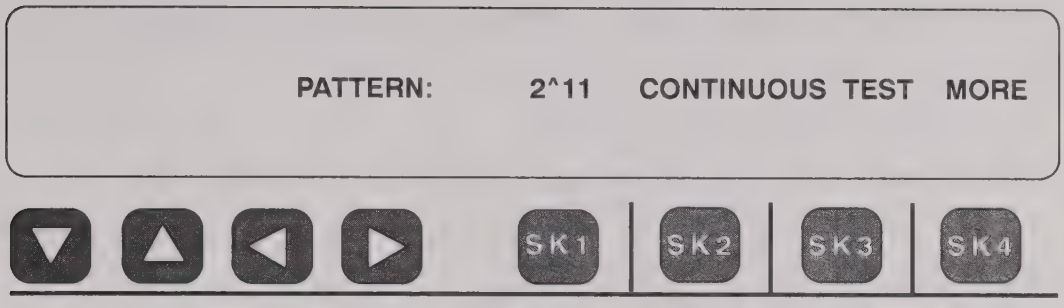
get to **Menu Option 56: DS-1 BIT ERROR RATE**.



Enter Menu Option 56 by pressing any of the softkeys under the display and the main selection menu will be displayed. You can also enter the number **56** from the keypad and then press the **ENT** (Enter) key.



If you want to begin testing right away, press Softkey 2 under **TEST** and the 930A will start sending the last test pattern it was set to. Most of the time though, you will want to check your settings and maybe make some changes. Press Softkey 1 under **SET-UP** in the display above and the Set-Up menu will be displayed. An example is shown on the following page.



Here the default pattern is the pseudo-random sequence of 2^{11}-1 or 2047 bits length and the test will run continuously. You can choose other patterns by pressing softkey 1 to scroll through the choices. The patterns are:

2^{11}-1	(2047 bits)
2^{9}-1	(511 bits)
1 : 7	(a 1 and 7 zeroes)
USER	(user inputs any 8 bit pattern)

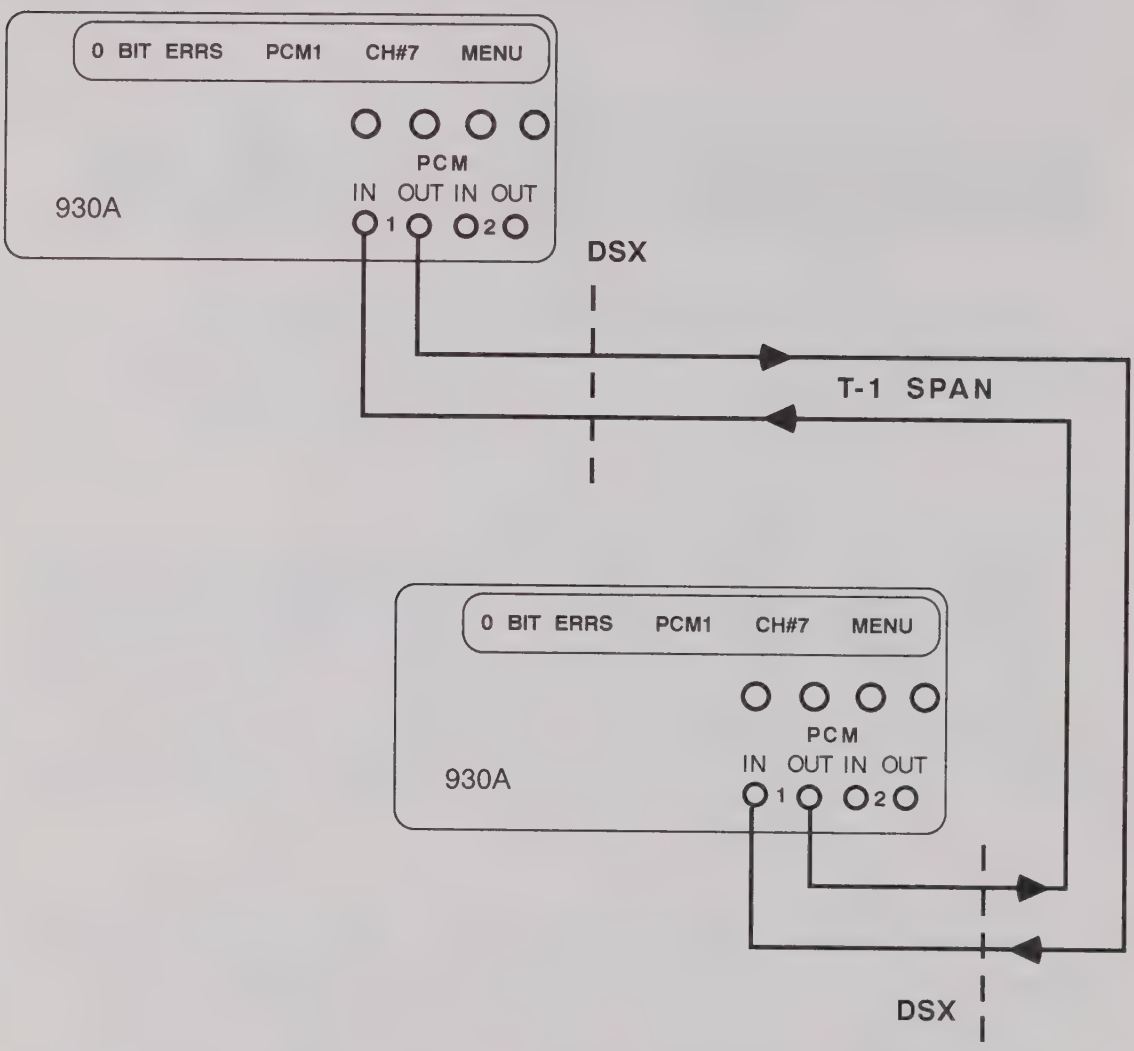
To input a USER pattern, select **USER** by pressing Softkey 1 until **USER** appears and then press Softkey 4 under **MORE**. You can then enter any 8 bit pattern of 1's and 0's you wish. The pattern will be continuously repeated when you begin testing. Press Softkey 4 under **EXIT** to return to the main menu.

The test length default is continuous but you can set the test length to run for 15 minutes, 1 hour or 24 hours if you want. Press Softkey 3 to choose which test length you want. Pressing Softkey 4 under **MORE** or pressing the Option Menu function key will return you to the main menu display.

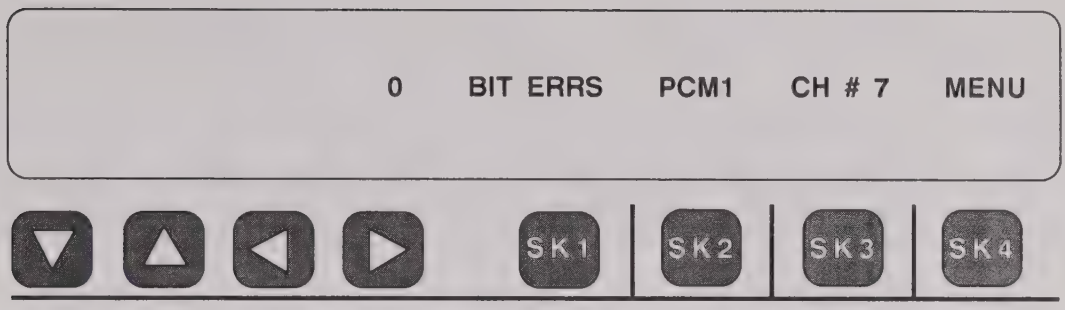
6-18.2 DS-0 BER TESTING

This section describes the steps and procedures used in testing 56 KBps and 64 KBps trunks carrying digital data. The first question you may have is "How do I tell the 930A whether the trunk is 56 KBps or 64 KBps?" The answer is that the 930A takes care of this for you when you set up the T-1 PCM Trunk Type. If you set the 930A for "AMI" line code and "Robbed Bit" signaling this tells it to set the DS-0 rate to 56 KBps. If you select "B8ZS" line code and "CCIS" signaling then the DS-0 rate is set to 64 KBps. So, setting up the T-1 trunk interface sets many of the parameters you need for DS-0 BERT. The next step is to determine how to test the DS-0 path.

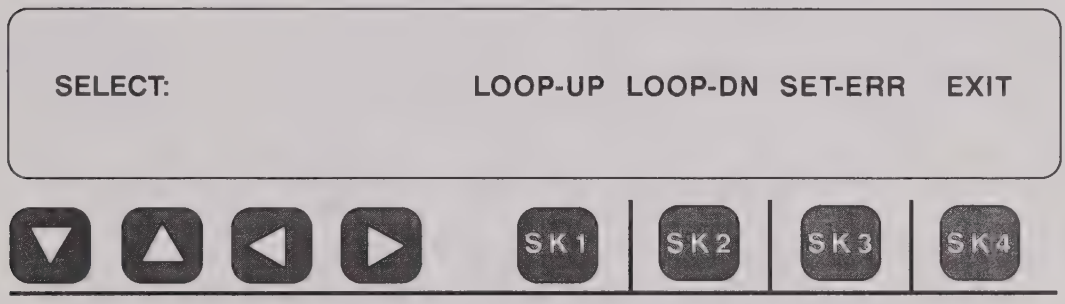
6-18.2.1 POINT-TO-POINT BER TESTING USING TWO 930As



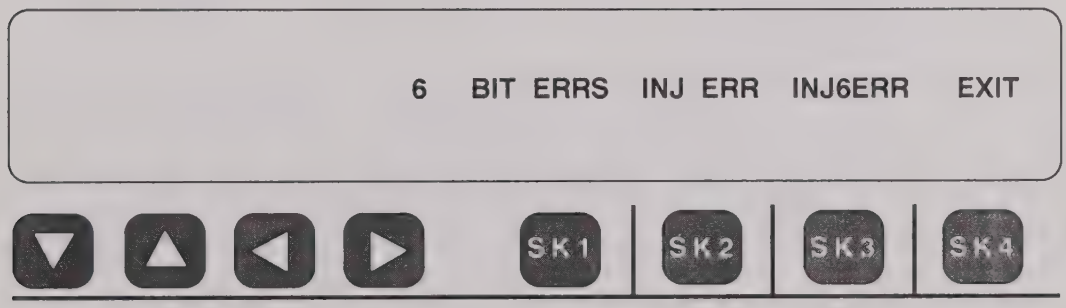
If you were testing point-to-point over a T-1 span and simply wanted to measure the Bit Error Rate on one of the channels you could do this by simply having a 930A at each end of the span. Set the 930As to send on the same channel and then set them both to send the same pattern toward each other. Both units would normally also be set to EXTERNAL Clock in the PCM TRUNK TYPE display. In some cases it may be necessary to have one 930A supply the clock and so one unit would be set to INTERNAL Clock.



Ideally, you would achieve sync and there would be no bit errors on the main display. To test the integrity of the connection you might force some errors over the channel under test to see if they get counted properly. You press Softkey 4 under **MENU** and the display would show:



Pressing Softkey 3 under **SET-ERR** allows you to send a single bit error or 6 bit errors at a time.



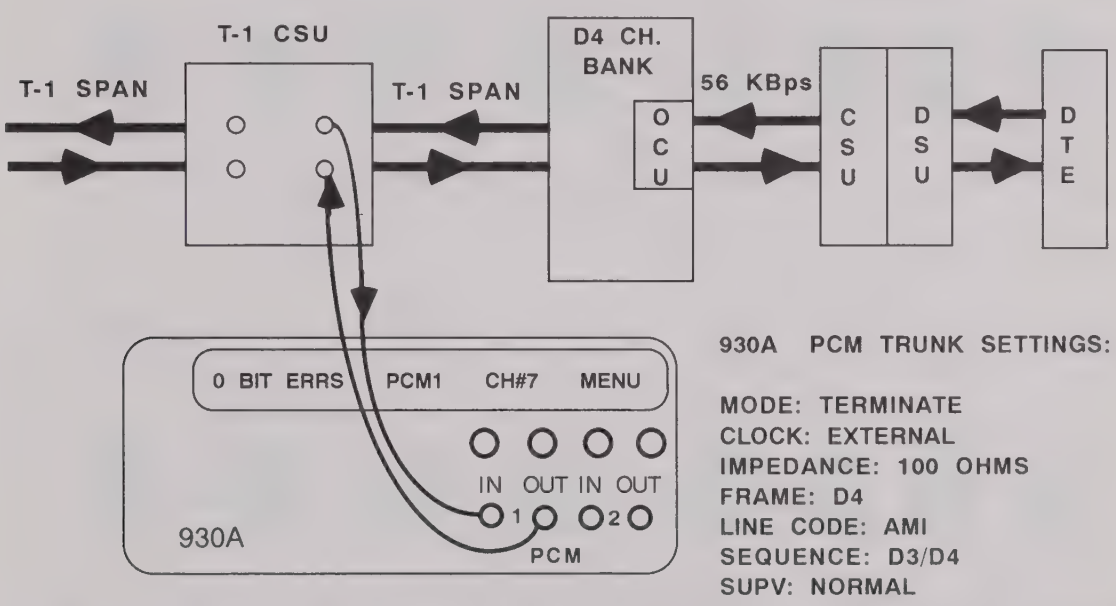
From this display you can count errors as well as inject them. If you press Softkey 4, you exit back to the main display.

You can also force one of the 930As to throw a **loopback** on the DS-0 channel under test. You can do this by first selecting **Menu Option 57: DS-0 LOOPBACK** and then selecting Digital Loopback. The channel you have selected under the PCM Trunk Type will then be looped back. The other 23 channels will remain as they were. **DO NOT USE** the VF Loopback except for analog tones. VF Loopback will not work with digital BER patterns. You can also access your selection from **Menu Option 4: DIGIT RECEIVER** as described in Section 4-1.

6-18.2.2 LOOPBACK BER TESTING ON 56 KBps DDS TRUNKS

Bit Error Testing on Dataphone Digital Service® (DDS) is in many ways easier than point-to-point testing. This is because DDS equipment responds to digital loop-up and loop-down commands. That means you can test from one 930A into the DS-0 channel and there is no need to have another 930A at the far end.

Again, the first step is to set up the 930A to either terminate the T-1 span or for Drop and Insert. You can connect the test cords at the DSX or at a T-1 CSU. The diagram below will serve as a discussion point.

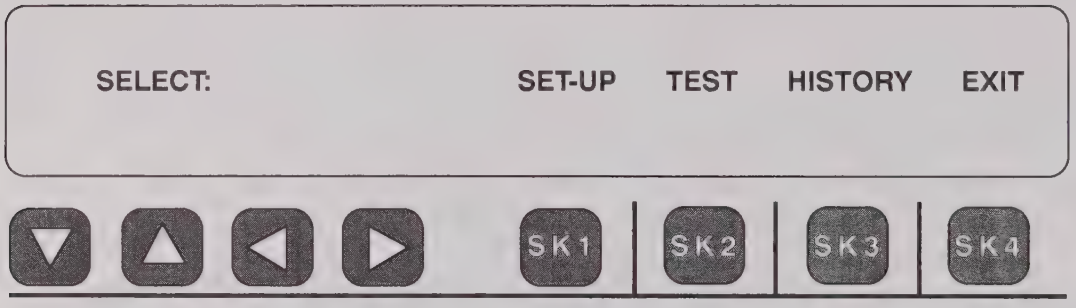


930A PCM TRUNK SETTINGS:

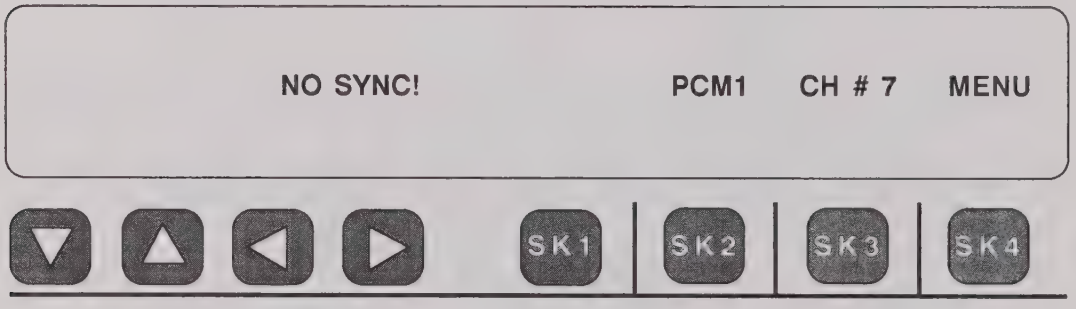
MODE: TERMINATE
CLOCK: EXTERNAL
IMPEDANCE: 100 OHMS
FRAME: D4
LINE CODE: AMI
SEQUENCE: D3/D4
SUPV: NORMAL

In this case the equipment side of the T-1 CSU is connected to a D4 channel bank which in turn feeds a 56 KBps OCU on Channel 7 to a CSU/DSU. Testing would normally begin by looping the DSU back and running a BER test for 15 minutes or so with a number of different stress patterns. If errors are not encountered the trunk is probably good. If errors are encountered then you must successively loop back the equipment on the trunk to determine where the problem is. If you loop back the 56 KBps CSU next, repeat the test patterns and find no errors, then the DSU is bad. If the errors still persist, then loop back the OCU. If you get errors then the OCU is bad. If you do not get errors, then it is a safe bet that the CSU is bad or the line interface connection to it is bad.

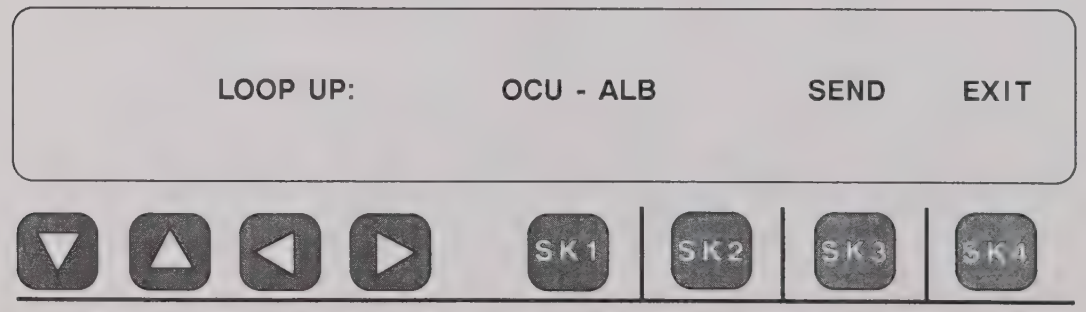
A brief run down on how to perform loop-back testing with the 930A follows. First, you begin with connecting the 930A to the T-1 span as previously described. Then you select Menu Option 56: DS-0 BERT. You enter the SET-UP menu and select the stress pattern you wish to send or create your own from the USER selection. At this point you return to the main menu by pressing the OPTION MENU key once. The display should be:

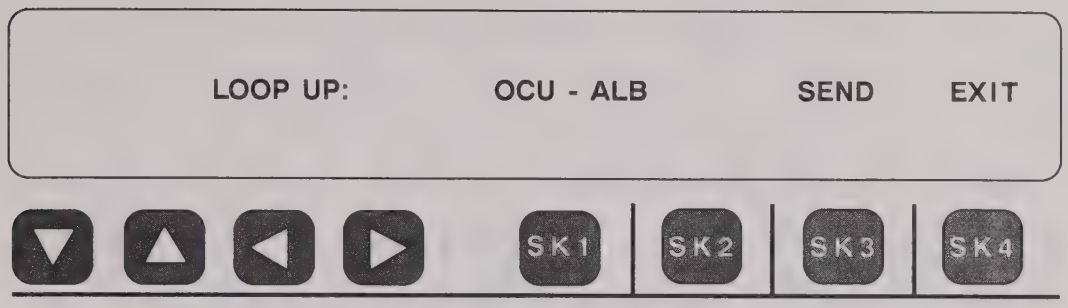


Next, press Softkey 2 under **TEST** and the main BER display will appear.



In this case we have **NO SYNC** because we have not yet looped back the far end device. No pattern is being returned to sync on. To loop the far end device, you press Softkey 4 under **MENU** and the following display appears:

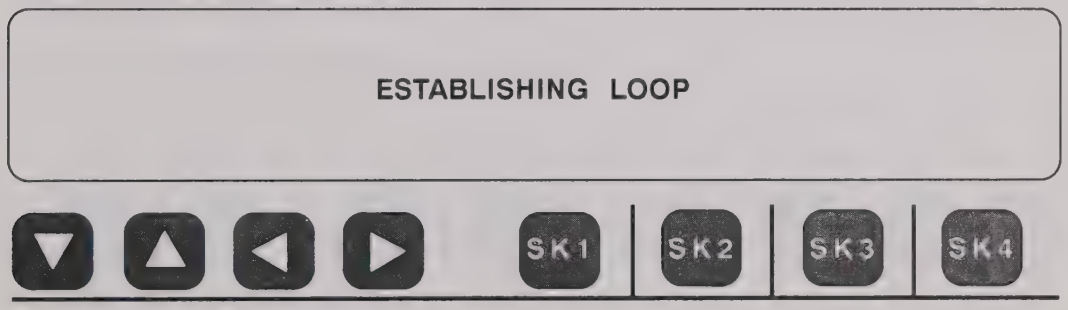




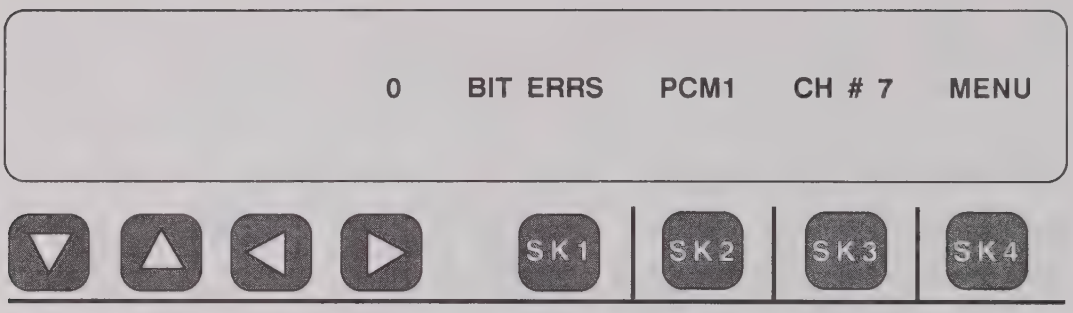
The loop-back patterns which the 930A can send are:

OCU-ALB	OCU Alternating Loopback
CSU-ALB	CSU Alternating Loopback
DSU-ALB	DSU Alternating Loopback
Repeater 1-ALB	Repeater 1 Alternating Loopback
Repeater 2-ALB	Repeater 2 Alternating Loopback
DP DROP-LLB	Dataport Drop-Latching Loopback
OCU-LLB	OCU Latching Loopback
CSU-LLB	CSU Latching Loopback

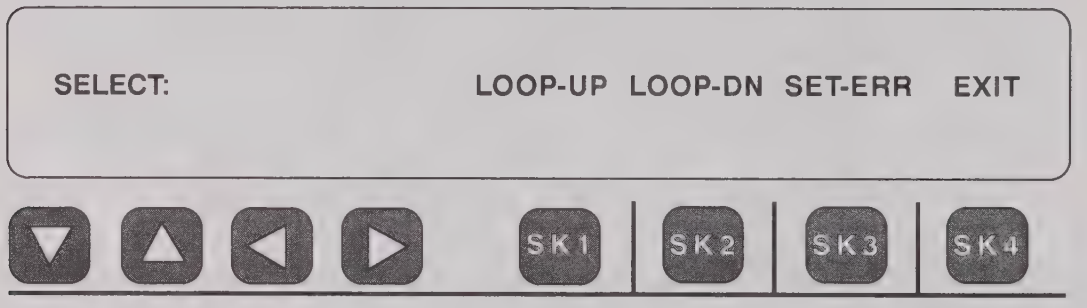
Select the correct pattern for your application by pressing Softkey 1 or using the UP/DOWN arrow keys. When the correct pattern is displayed, press Softkey 3 under **SEND** and the pattern will be transmitted. The 930A will respond with a screen:



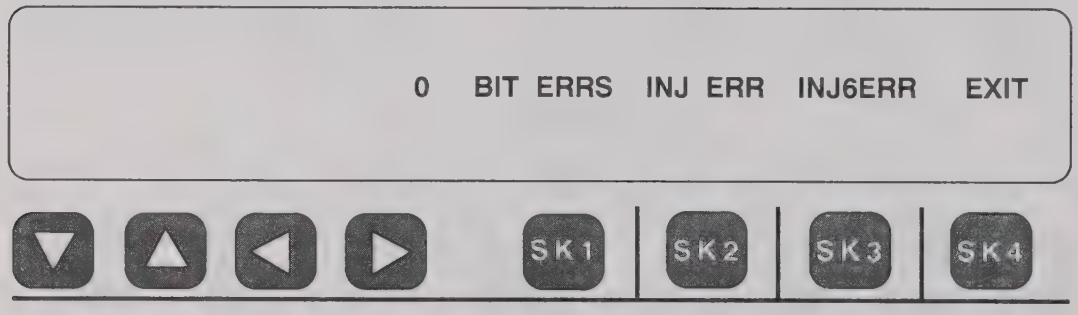
When the loopback is successful, the 930A display will show the main BER display screen.



Note that the **NO SYNC** indication has now been replaced by the Bit Errors count. To test the integrity of the loop, you can send a single error to see if it comes back. Press Softkey 4 under **MENU** and go to the **SET-ERR** function.



Press Softkey 3 under **SET-ERR** and the display changes to:

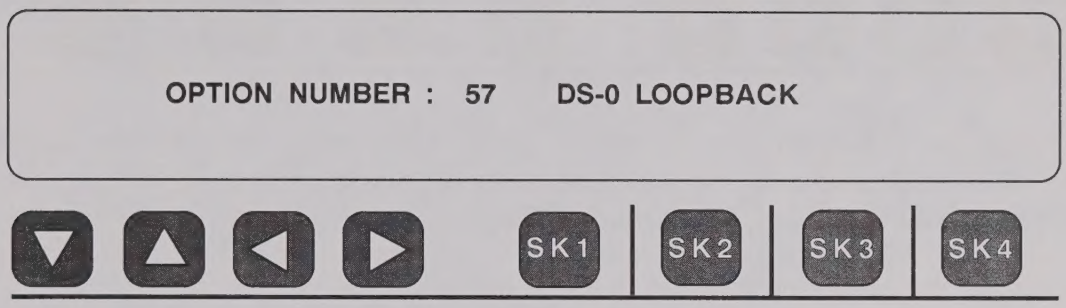


At this point you can press Softkey 2 under **INJ ERR** and a single error will appear on the display if you have loop integrity.

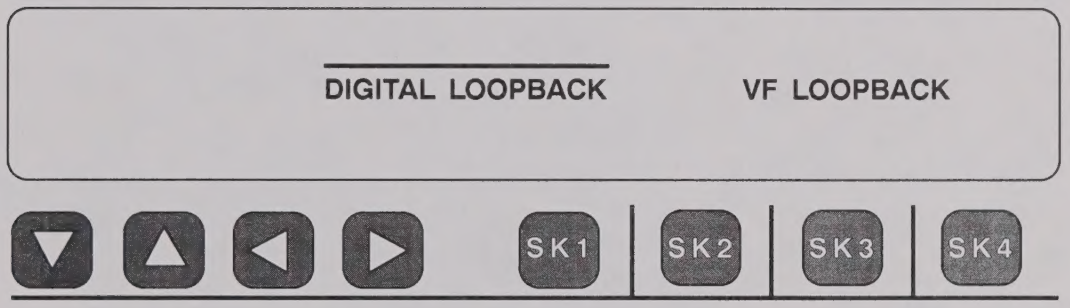
You can change test patterns if you wish by re-entering the set-up menu. Whatever you do, the 930A will resend the selected loopback code automatically when you re-enter the **TEST** menu.

6-18.3 HOW TO MAKE THE 930A GIVE A LOOPBACK

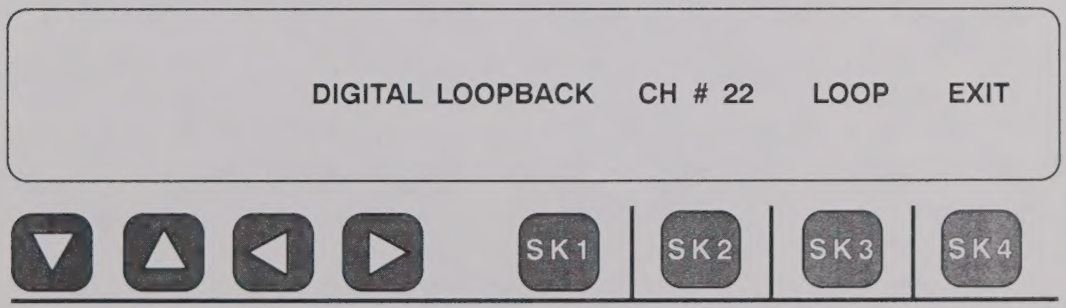
The 930A can loop back the selected PCM channel in TERMINATE or Drop and Insert modes. This is similar to a hard loopback in operation because no codes are involved. You simply select **Menu Option 57: DS-0 LOOPBACK**.

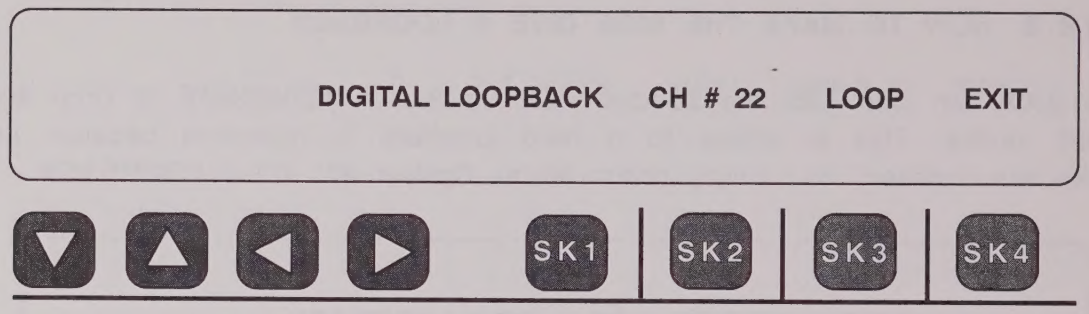


Pressing any softkey will bring up the loopback selection display:



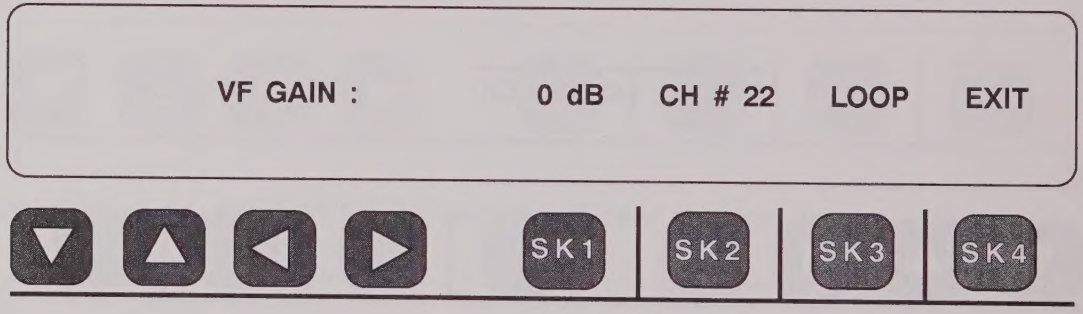
The default is **DIGITAL LOOPBACK**. This is the type you must choose if digital patterns are going to be looped back. That is, pseudo-random patterns such as the 511 or 2047 bit long patterns. If tones (e.g., 1004 Hz) are being sent toward you then you want to choose the **VF LOOPBACK**. Select **DIGITAL LOOPBACK** by pressing Softkey 1 and the display will become:





To initiate a loopback press Softkey 3 under **LOOP** and a cursor will appear over **LOOP** indicating that the selected channel has been looped back. In this example, Channel 22 has been looped back since it was the selected channel in trunk type. To loop back a different channel you must return to the PCM Trunk Type menu and change the channel there.

If you select **VF LOOPBACK** instead, the display is somewhat different:



Here, you have the opportunity to insert gain or attenuation. The default is 0 dB but you can enter any number between +2 dB and -16 dB by pressing Softkey 1 and then using the keypad to enter the desired value. The VF Loopback also retains the companding algorithm which is suspended during a digital loopback.

To initiate a VF Loopback, press Softkey 3 under **LOOP** just as you would for a digital loopback.

Pressing Softkey 4 under **EXIT** will take down the loop and return the 930A to its normal state. Note that only the selected channel is looped. The other 23 channels pass through unimpaired.

ACCOPRESS®

25070	YELLOW
25071	BLACK
25072	LIGHT BLUE
25073	DARK BLUE
25074	LIGHT GRAY
25075	LIGHT GREEN
25076	DARK GREEN
25077	TANGERINE
25078	RED
25079	EXECUTIVE RED

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